Allen-Bradley

MicroLogix™ 1200 Programmable Controllers

Bulletin 1762 Controllers and Expansion I/O

User Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Rockwell Automation office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this manual we use notes to make you aware of safety considerations:

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

MicroLogix, ControlFlash, RSLogix, and RSLinx are trademarks of Rockwell Automation.
PLC-5 is a registered trademark of Rockwell Automation.
Belden is a trademark of Belden, Inc.
DeviceNet is a trademark of The Open DeviceNet Vendors Association.
Modbus is a trademark of Modicon, Inc.

Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- conventions used in this manual
- Rockwell Automation support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use MicroLogix 1200 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Purpose of this Manual

This manual is a reference guide for MicroLogix 1200 controllers and expansion I/O. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the MicroLogix 1200 controller system

Refer to Publication 1762-RM001A-US-P, *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual* for the MicroLogix 1200 and 1500 instruction set and for application examples to show the instruction set in use. Refer to your programming software user documentation for more information on programming your MicroLogix 1200 controller.

Related Documentation

The following documents contain additional information concerning Rockwell Automation products. To obtain a copy, contact your local Rockwell Automation office or distributor.

For	Read this Document	Document Number
Information on understanding and applying micro controllers.	MicroMentor	1761-MMB
Information on the MicroLogix 1200 Controllers instruction set.	MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001A-US-P
Information on mounting and wiring the MicroLogix 1200 Controllers, including a mounting template for easy installation.	MicroLogix 1200 Programmable Controllers Installation Instructions	1762-5.1
A description on how to install and connect an AIC+. This manual also contains information on network wiring.	Advanced Interface Converter (AIC+) User Manual	1761-6.4
Information on how to install, configure, and commission a DNI.	DeviceNet™ Interface User Manual	1761-6.5
Information on DF1 open protocol.	DF1 Protocol and Command Set Reference Manual	1770-6.5.16
Information about the Modbus Slave protocol.	Modbus Protocol Specifications	Available from Schneider Automation, Inc.
In-depth information on grounding and wiring Allen-Bradley programmable controllers.	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices.	Application Considerations for Solid-State Controls	SGI-1.1
An article on wire sizes and types for grounding electrical equipment.	National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	
A complete listing of current documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages.	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations.	Allen-Bradley Industrial Automation Glossary	AG-7.1

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 Sales/ Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Rockwell Automation for technical assistance, please review the information in the *Troubleshooting* appendix first. Then call your local Rockwell Automation representative.

Your Questions or Comments on this Manual

If you find a problem with this manual, or you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

Rockwell Automation
Control and Information Group
Technical Communication, Dept. A602V
P.O. Box 2086
Milwaukee, WI 53201-2086

or visit our internet page at: http://www.ab.com/micrologix

Hardware Overview — **Chapter 1**

Hardware Features 1-1
Component Descriptions 1-2
Communication Cables. 1-3
Programming 1-3
Communication Options 1-3

Installing Your Controller — **Chapter 2**

Agency Certifications 2-1
Compliance to European Union Directives. 2-2
Installation Considerations 2-3
Safety Considerations 2-4
Power Considerations 2-6
Preventing Excessive Heat. 2-8
Master Control Relay 2-8
Installing a Memory Module and/or Real-Time Clock 2-13
Controller Mounting Dimensions. 2-14
Controller and
Expansion I/O Spacing 2-14
Mounting the Controller. 2-15
Mounting 1762
Expansion I/O. 2-18
Connecting Expansion I/O 2-20

Wiring Your Controller — **Chapter 3**

Wiring Requirements 3-1
Using Surge Suppressors 3-3
Grounding the Controller. 3-6
Wiring Diagrams. 3-7
Sinking and Sourcing Wiring Diagrams 3-10
Controller I/O Wiring 3-14
Expansion I/O Wiring. 3-14

Communication Connections — **Chapter 4**

Default Communication Configuration 4-1
Using the Communications Toggle Push Button 4-2
Connecting to the RS-232 Port. 4-2
Connecting to a DH485 Network 4-7
Connecting the AIC+ 4-10
DeviceNet Communications. 4-17

Using Trim Pots — **Chapter 5**
Trim Pot Operation 5-1

Using Real-Time Clock and Memory Modules — **Chapter 6**
Real-Time Clock Operation 6-1
Memory Module Operation 6-3

Specifications — **Appendix A**
Controller Dimensions A-6
Expansion I/O Dimensions A-6

Replacement Parts — **Appendix B**
MicroLogix 1200 Replacement Kits B-1
1762 Expansion I/O B-3

Troubleshooting Your System — **Appendix C**
Understanding the Controller LED Status C-1
Controller Error Recovery Model C-3
Analog Expansion I/O Diagnostics and Troubleshooting C-4
Calling Rockwell Automation for Assistance C-7

Using Control Flash to Upgrade Your Operating System — **Appendix D**
Preparing for Upgrade D-1
Sequence of Operation D-2
Missing/Corrupt OS LED Pattern D-2

Understanding the Communication Protocols — **Appendix E**
RS-232 Communication Interface E-1
DF1 Full-Duplex Protocol E-1
DF1 Half-Duplex Protocol E-3
DH485 Communication Protocol E-8
Modbus Communication Protocol E-17

System Loading and Heat Dissipation — **Appendix F**
System Loading Limitations F-1
System Loading Worksheet F-3
System Loading Worksheet F-7
Calculating Heat Dissipation F-9

Glossary

Index

Hardware Overview

Hardware Features

The Bulletin 1762, MicroLogix 1200 programmable controller contains a power supply, input and output circuits, and a processor. The controller is available in 24 I/O and 40 I/O configurations.

The hardware features of the controller are:

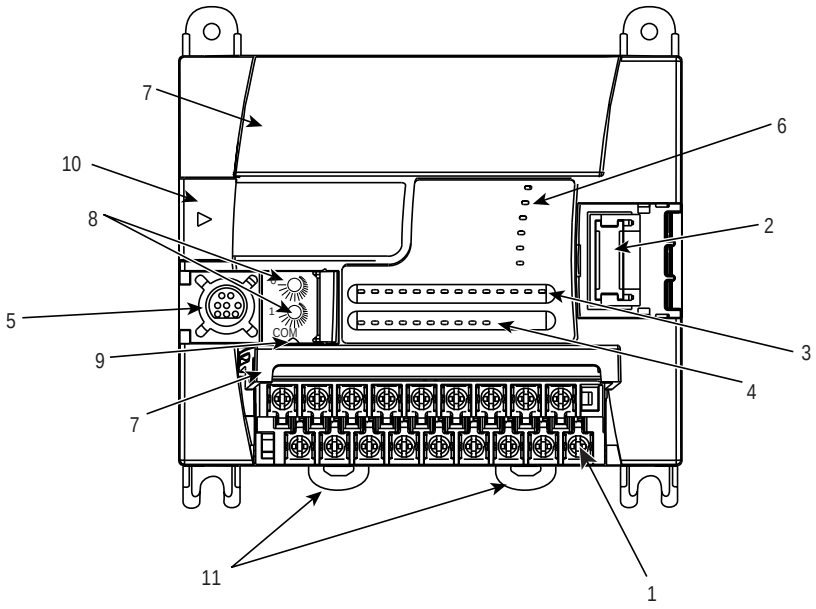


Table 1.1 Hardware Features

Feature	Description	Feature	Description
1	Terminal Blocks (Removable Terminal Blocks 1762-40xWA only)	7	Terminal Doors and Labels
2	Bus Connector Interface to Expansion I/O	8	Trim Pots
3	Input LEDs	9	Communications Toggle Push Button
4	Output LEDs	10	Memory Module Port Cover(1) -or- Memory Module and/or Real-Time Clock(2)
5	Communication Port/ Channel 0	11	DIN Rail Latches
6	Status LEDs		

(1) Shipped with controller.

(2) Optional equipment.

Component Descriptions

MicroLogix 1200 Memory Module and/or Real-Time Clock

The controller is shipped with a memory module port cover in place. You can order a memory module, real-time clock, or memory module and real-time clock as an accessory.

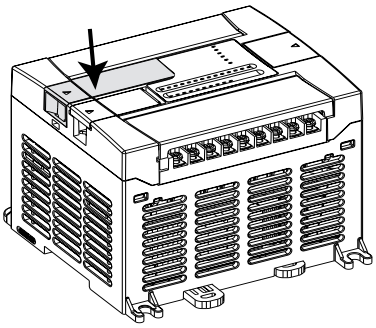


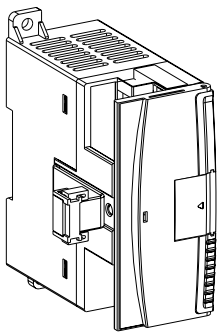
Table 1.2 Memory Module and/or Real-Time Clock

Catalog Number	Descriptions
1762-MM1	Memory Module only
1762-RTC	Real-Time Clock only
1762-MM1RTC	Memory Module and Real-Time Clock

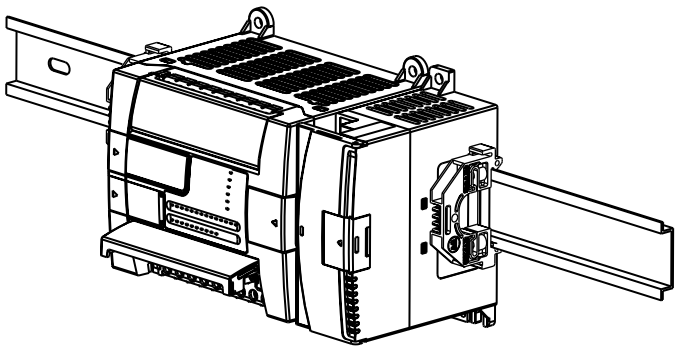
1762 Expansion I/O

1762 expansion I/O can be connected to the MicroLogix 1200 controller, as shown below. A maximum of six I/O modules, in certain combinations, may be connected to a controller. Refer to System Loading and Heat Dissipation on page F-1.

1762 Expansion I/O



1762 Expansion I/O Connected to MicroLogix 1200 Controller



Communication Cables

Use only the following communication cables with the MicroLogix 1200 controllers.

- 1761-CBL-PM02 Series C or later
- 1761-CBL-HM02 Series C or later
- 1761-CBL-AM00 Series C or later
- 1761-CBL-AP00 Series C or later
- 2707-NC8 Series B or later
- 2702-NC9 Series B or later
- 2707-NC10 Series B or later
- 2707-NC11 Series B or later

Programming

Programming the MicroLogix 1200 programmable controller is done using RSLogix™ 500, Revision 4 or later. Communication cables for programming are not included with the software.

Communication Options

The MicroLogix 1200 can be connected to a personal computer. It can also be connected to the DH485 network using an Advanced Interface Converter (catalog number 1761-NET-AIC) and to the DeviceNet™ network using a DeviceNet Interface (catalog number 1761-NET-DNI). The controller can also be connected to Modbus™ SCADA networks as an RTU slave. Refer to Communication Connections on page 4-1 for more information on connecting to the available communication options.

Installing Your Controller

This chapter shows you how to install your controller. The only tools you require are a flat or Phillips head screwdriver and drill. Topics include:

- agency certifications
- compliance to European Union Directives
- installation considerations
- safety considerations
- power considerations
- preventing excessive heat
- master control relay
- installing the memory module and/or real-time clock
- controller mounting dimensions
- controller and expansion I/O spacing
- mounting the controller
- mounting 1762 expansion I/O
- connecting expansion I/O

Agency Certifications

- UL 508
- C-UL under CSA C22.2 no. 142
- Class I, Division 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213)
- CE compliant for all applicable directives
- C-Tick compliant for all applicable acts.

Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B111

Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2[1]) to reduce the effects of electrical interference (Over Voltage Category II[2]) and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

ATTENTION

Vertical mounting of the controller is not recommended due to heat build-up considerations.

ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller or I/O modules could cause damage. Do not drill holes above a mounted controller if the protective debris shields are removed or the processor is installed.

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occasionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off.
- Do not connect or disconnect components unless power has been switched off.
- This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.
- All wiring must comply with N.E.C. article 501-4(b).

Use only the following communication cables in Class I, Division 2 hazardous locations.

Environment Classification	Communication Cables
Class I, Division 2 Hazardous Environment	1761-CBL-PM02 Series C or later
	1761-CBL-HM02 Series C or later
	1761-CBL-AM00 Series C or later
	1761-CBL-AP00 Series C or later
	2707-NC8 Series B or later
	2707-NC9 Series B or later
	2707-NC10 Series B or later
	2707-NC11 Series B or later

Disconnecting Main Power

WARNING

Explosion Hazard - Do not replace components or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

Safety Circuits

WARNING

Explosion Hazard - Do not connect or disconnect connectors while circuit is live.

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a dc power supply, interrupt the load side rather than the ac line power. This avoids the additional delay of power supply turn-off. The dc power supply should be powered directly from the fused secondary of the transformer. Power to the dc input and output circuits should be connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Power Considerations

The following explains power considerations for the micro controllers.

Isolation Transformers

You may want to use an isolation transformer in the ac line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

Power Supply Inrush

During power-up, the MicroLogix 1200 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the MicroLogix 1200 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

Loss of Power Source

The power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called “program scan hold-up time after loss of power.” The duration of the power supply hold-up time depends on the type and state of the I/O, but is typically between 10 milliseconds and 3 seconds. When the duration of power loss reaches this limit, the power supply signals the processor that it can no longer provide adequate dc power to the system. This is referred to as a power supply shutdown. The processor then performs an orderly shutdown of the controller.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from “On” to “Off” that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce “hot spots” near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

NOTE Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. Refer to the figures on pages 2-11 and 2-12.

ATTENTION Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

NOTE

If you are using an external dc power supply, interrupt the dc output side rather than the ac line side of the supply to avoid the additional delay of power supply turn-off.

The ac line of the dc output power supply should be fused.

Connect a set of master control relays in series with the dc power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

NOTE

Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Using Emergency-Stop Switches

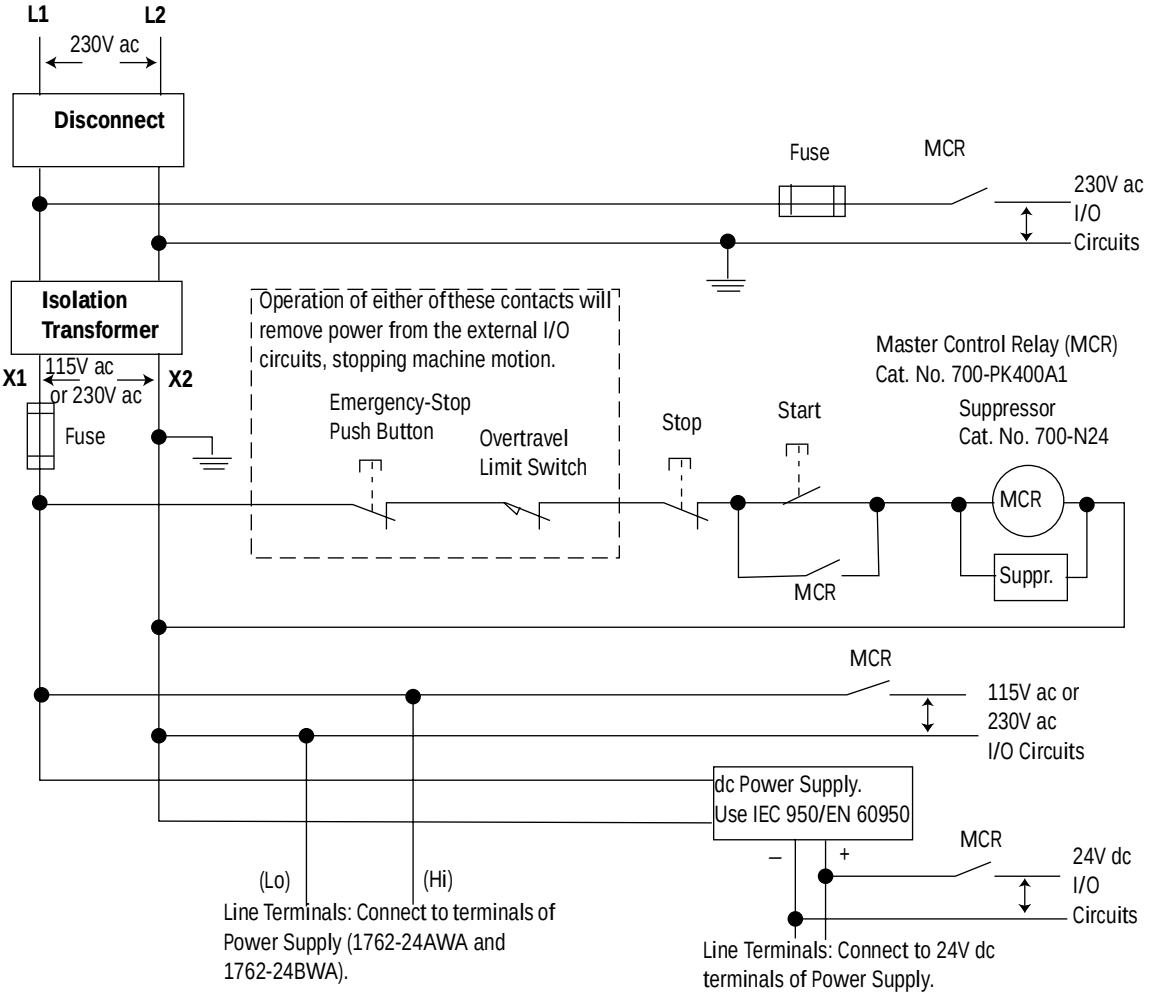
When using emergency-stop switches, adhere to the following points:

- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.
- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

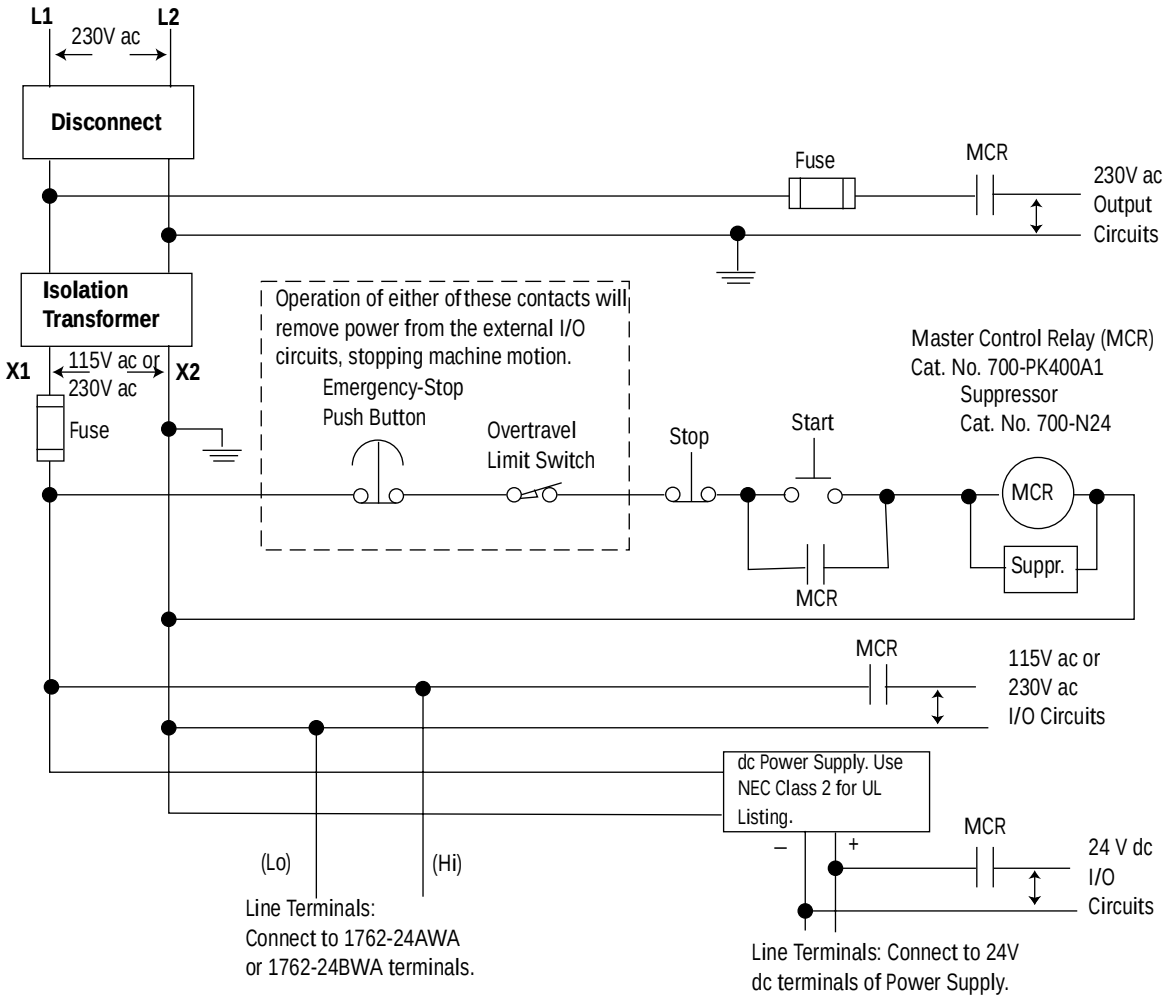
The following illustrations show the Master Control Relay wired in a grounded system.

NOTE In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

Schematic (Using IEC Symbols)

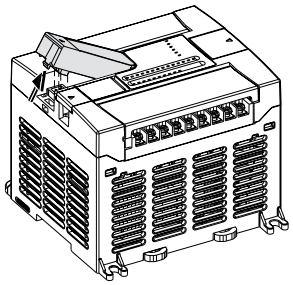


Schematic (Using ANSI/CSA Symbols)

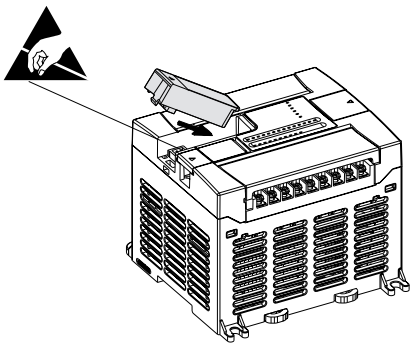


Installing a Memory Module and/or Real-Time Clock

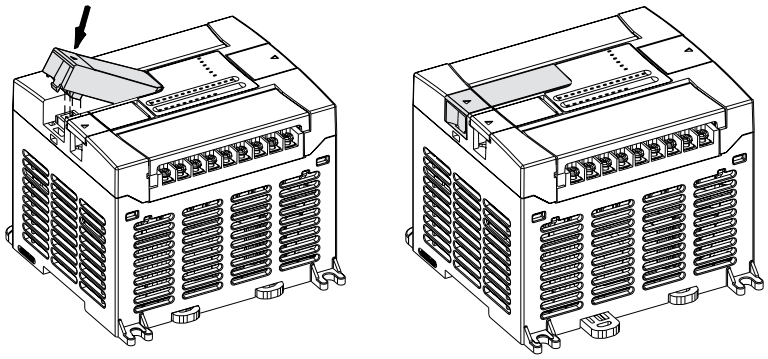
1. Remove the memory module port cover.



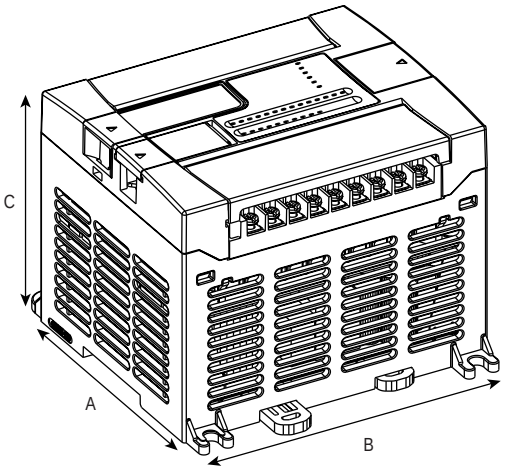
2. Align the connector on the memory module with the connector pins on the controller.



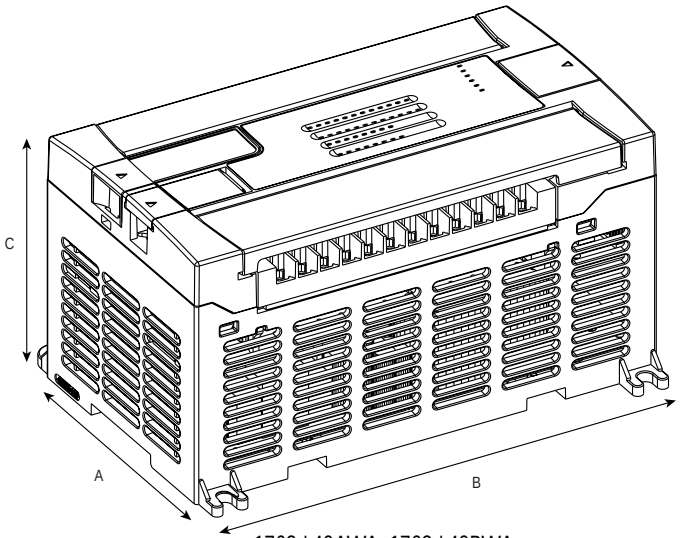
3. Firmly seat the memory module into the controller.



Controller Mounting Dimensions



1762-L24AWA, 1762-L24BWA



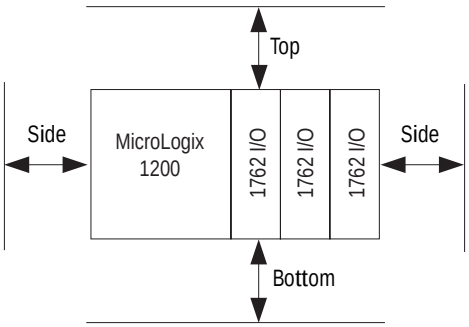
1762-L40AWA, 1762-L40BWA

Table 2.1

Dimension	1762-L24AWA	1762-L24BWA	1762-L40AWA	1762-L40BWA
A	90 mm (3.5 in.)		90 mm (3.5 in.)	
B	110 mm (4.33 in.)		160 mm (6.30 in.)	
C	87 mm (3.43 in.)		87 mm (3.43 in.)	

Controller and Expansion I/O Spacing

The controller mounts horizontally, with the expansion I/O extending to the right of the controller. Allow 50 mm (2 in.) of space on all sides of the controller system for adequate ventilation. Maintain spacing from enclosure walls, wireways, adjacent equipment, etc., as shown below.

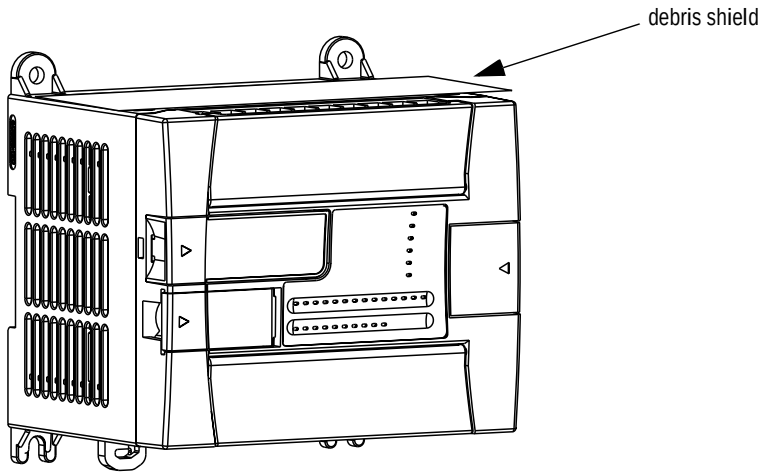


Mounting the Controller

MicroLogix™ 1200 Controllers are suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[(1)]) and to circuits not exceeding Over Voltage Category II[(2)] (IEC 60664-1).[(3)]

ATTENTION

Do not remove the protective debris shield until after the controller and all other equipment in the panel near the controller are mounted and wiring is complete. Once wiring is complete, remove protective debris shield. Failure to remove shield before operating can cause overheating.



ATTENTION

Electrostatic discharge can damage semiconductor device inside the controller. Do not touch the connector pins or other sensitive area.

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

DIN Rail Mounting

The maximum extension of the latch is 14 mm (0.55 in.) in the open position. A flat-blade screwdriver is required for removal of the controller. The controller can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.

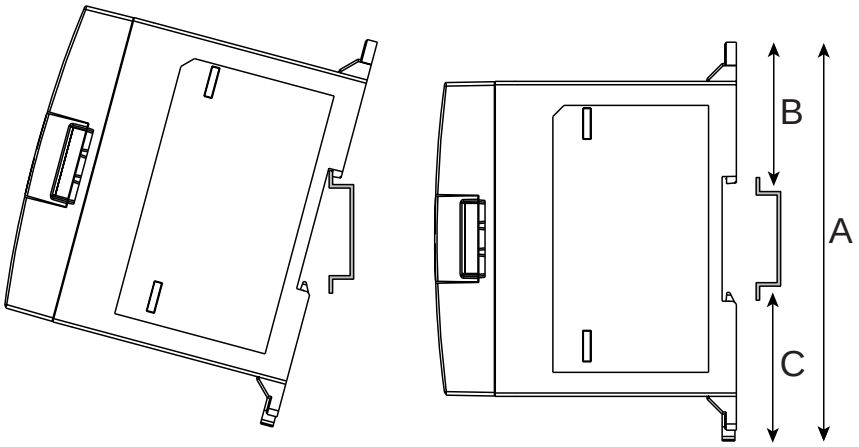


Table 2.2 Controller Dimensions

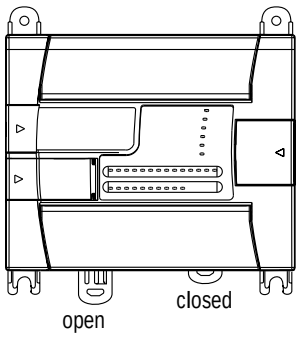
Dimension	Height
A	90 mm (3.5 in.)
B	27.5 mm (1.08 in.)
C	27.5 mm (1.08 in.)

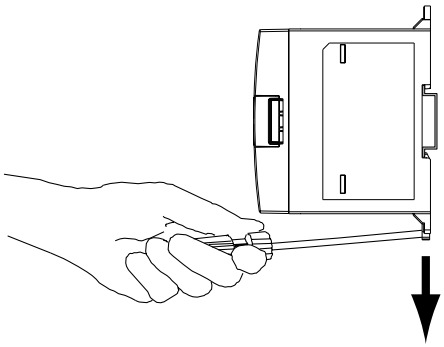
To install your controller on the DIN rail:

1. Mount your DIN rail. (Make sure that the placement of the controller on the DIN rail meets the recommended spacing requirements, see Controller and Expansion I/O Spacing on page 2-14. Refer to the mounting template inside the back cover of this document.)
2. Close the DIN latch, if it is open.
3. Hook the top slot over the DIN rail.
4. While pressing the controller down against the top of the rail, snap the bottom of the controller into position.
5. Leave the protective debris shield attached until you are finished wiring the controller and any other devices.

To remove your controller from the DIN rail:

1. Place a flat-blade screwdriver in the DIN rail latch at the bottom of the controller.
2. Holding the controller, pry downward on the latch until the latch locks in the open position.
3. Repeat steps 1 and 2 for the second DIN rail latch.
4. Unhook the top of the DIN rail slot from the rail.





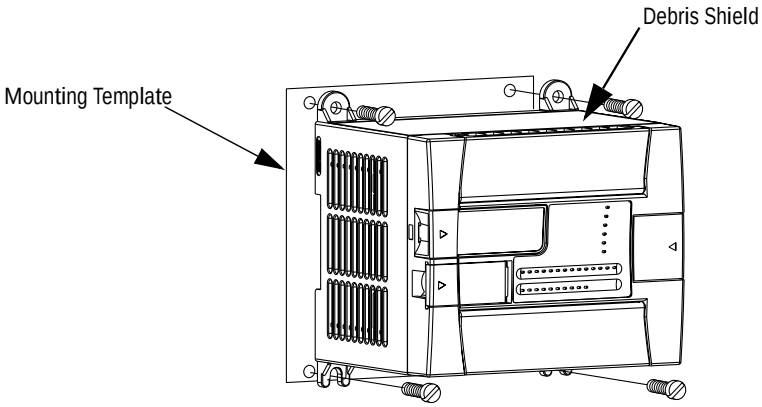
Panel Mounting

Mount to panel using #8 or M4 screws. To install your controller using mounting screws:

1. Remove the mounting template from inside the back cover of the *MicroLogix 1200 Programmable Controllers Installation Instructions*, publication 1762-IN006A-ML-P.
2. Secure the template to the mounting surface. (Make sure your controller is spaced properly. See Controller and Expansion I/O Spacing on page 2-14.)
3. Drill holes through the template.
4. Remove the mounting template.

5. Mount the controller.

6. Leave the protective debris shield in place until you are finished wiring the controller and any other devices.



Mounting 1762 Expansion I/O

ATTENTION

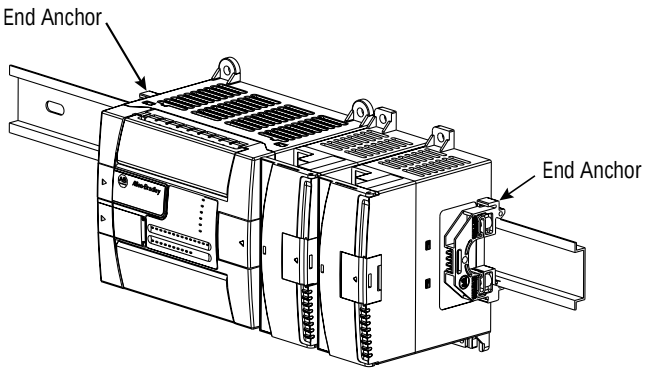
During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire stands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage when the module is under power.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latch. Press the DIN rail mounting area of the module against the DIN rail. The latch momentarily opens and locks into place.

Use DIN rail end anchors (Allen-Bradley part number 1492-EA35 or 1492-EAH35) for vibration or shock environments. The following illustration shows the location of the end anchors.



NOTE 1762 expansion I/O must be mounted horizontally as illustrated.

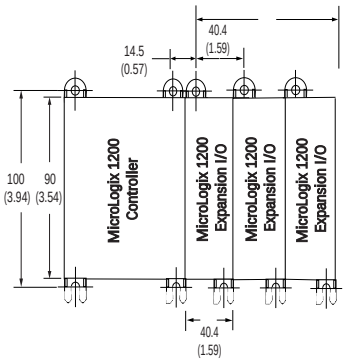
NOTE For environments with greater vibration and shock concerns, use the panel mounting method described below, instead of DIN rail mounting.

Panel Mounting

Use the dimensional template shown below to mount the module. The preferred mounting method is to use two M4 or #8 panhead screws per module. M3.5 or #6 panhead screws may also be used, but a washer is needed to ensure a good ground current. Mounting screws are required on every module.

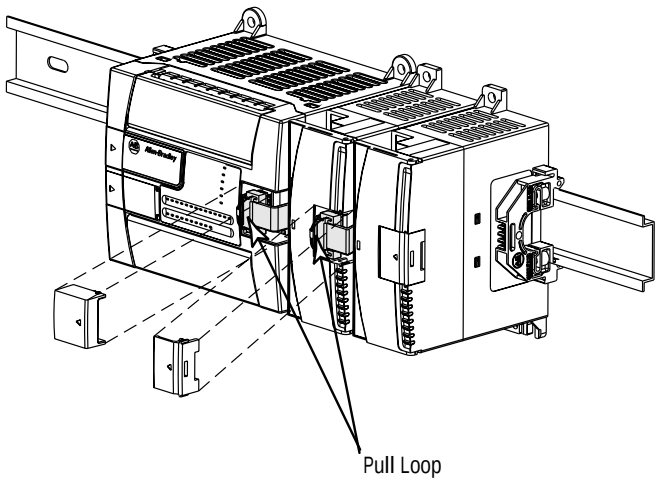
For more than 2 modules: (number of modules - 1) x 40 mm (1.58 in.)

NOTE: All dimensions are in mm (inches). Hole spacing tolerance: ±0.4 mm (0.016 in.).



Connecting Expansion I/O

The expansion I/O module is attached to the controller or another I/O module by means of a flat ribbon cable *after* mounting, as shown below.



NOTE Use the pull loop on the connector to disconnect modules. Do not pull on the ribbon cable.

ATTENTION

Remove power before removing or inserting an I/O module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing the controller to fault
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance, reducing product reliability.

WARNING

EXPLOSION HAZARD

In Class I, Division 2 applications, the bus connector must be fully seated and the bus connector cover must be snapped in place.

In Class I, Division 2 applications, all modules must be mounted in direct contact with each other as shown on page 2-20. If DIN rail mounting is used, an end stop must be installed ahead of the controller and after the last 1762 I/O module.

Wiring Your Controller

This chapter describes how to wire your controller and expansion I/O. Topics include:

- wire requirements
- using surge suppressors
- grounding the controller
- wiring diagrams
- sinking and sourcing wiring diagrams
- controller I/O wiring
- expansion I/O wiring

Wiring Requirements

Wiring Recommendation

ATTENTION

Before you install and wire any device, disconnect power to the controller system.

ATTENTION

Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.

United States Only: If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-4 (b).

- Allow for at least 50 mm. (2 in.) between I/O wiring ducts or terminal strips and the controller.
- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

NOTE Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for dc wiring and red for ac wiring.

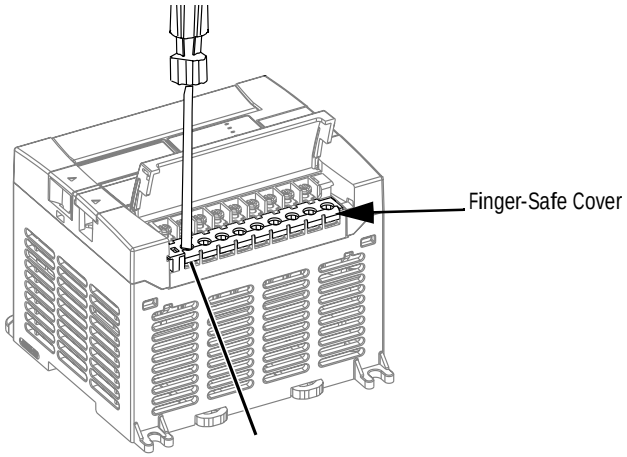
Table 3.1 Wire Requirements

Wire Type		Wire Size (2 wire maximum per terminal screw)
Solid	Cu-90°C (194°F)	#14 to #22 AWG
Stranded	Cu-90°C (194°F)	#16 to #22 AWG

Wiring torque = 0.791 Nm (7 in-lb) rated

Wiring without Spade Lugs

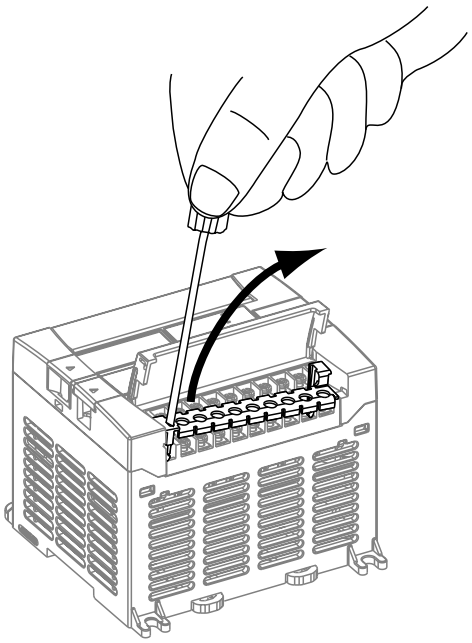
When wiring without spade lugs, it is recommended to keep the finger-safe covers in place. Loosen the terminal screw and route the wires through the opening in the finger-safe cover. Tighten the terminal screw making sure the pressure plate secures the wire.



Wiring with Spade Lugs

The diameter of the terminal screw head is 5.5 mm (0.220 in.). The input and output terminals of the MicroLogix 1200 controller are designed for a 6.35mm (0.25 in.) wide spade (standard for #6 screw for up to 14 AWG) or a 4 mm (metric #4) fork terminal.

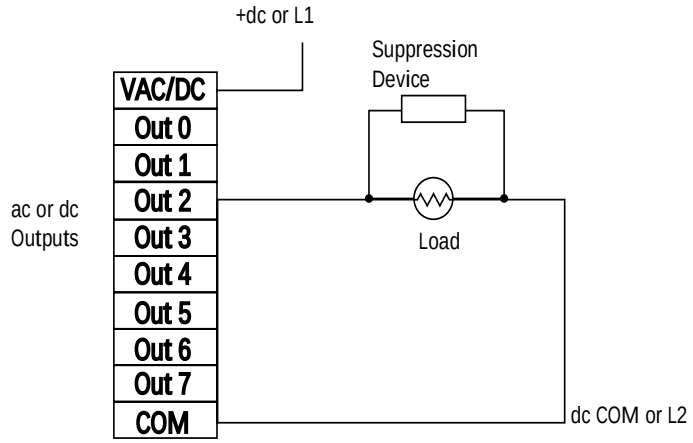
When using spade lugs, use a small, flat-blade screwdriver to pry the finger-safe cover from the terminal blocks as shown below. Then loosen the terminal screw.



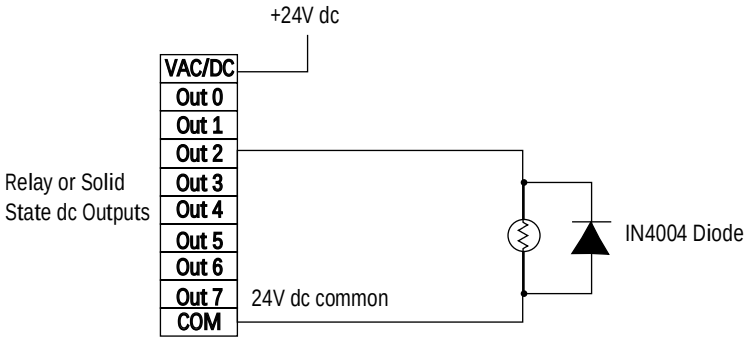
Using Surge Suppressors

Inductive load devices, such as motor starters and solenoids, require the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.

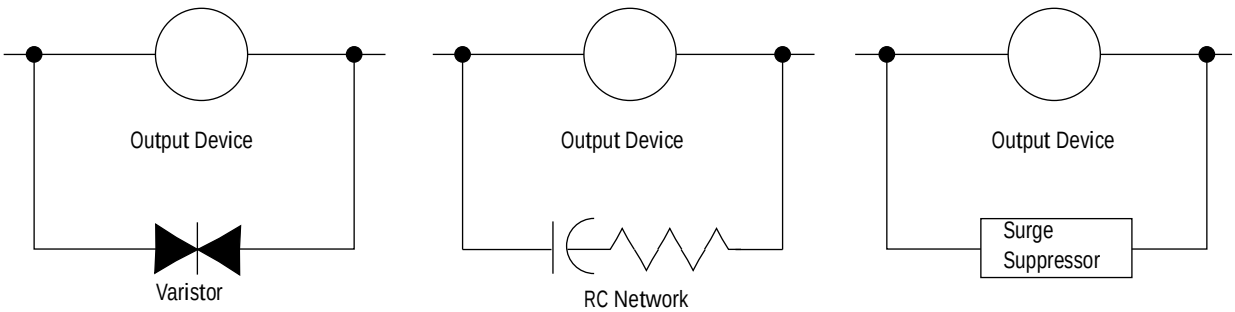


If the outputs are dc, we recommend that you use an 1N4004 diode for surge suppression, as shown below.



Suitable surge suppression methods for inductive ac load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching transient characteristic of the particular inductive device. See the table on page 3-5 for recommended suppressors.

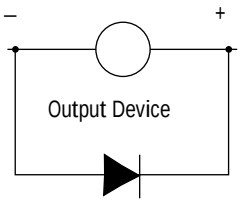
Surge Suppression for Inductive ac Load Devices



For inductive dc load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See Table 3.2 for recommended suppressors.

As shown below, these surge suppression circuits connect directly across the load device.

Surge Suppression for Inductive dc Load Devices



(A surge suppressor can also be used.)

Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors shown in the following table for use with relays, contactors, and starters.

Table 3.2 Recommended Surge Suppressors

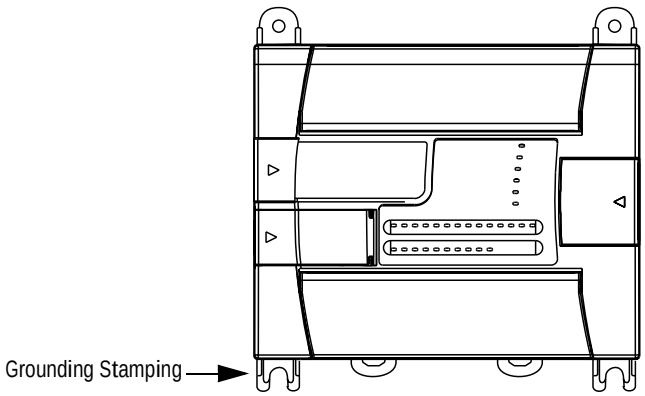
Device	Coil Voltage	Suppressor Catalog Number
Bulletin 509 Motor Starter Bulletin 509 Motor Starter	120V ac 240V ac	599-K04 599-KA04
Bulletin 100 Contactor Bulletin 100 Contactor	120V ac 240V ac	199-FSMA1 199-FSMA2
Bulletin 709 Motor Starter	120V ac	1401-N10
Bulletin 700 Type R, RM Relays	ac coil	None Required
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	12V dc 12V dc	700-N22 700-N28
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	24V dc 24V dc	700-N10 700-N13
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	48V dc 48V dc	700-N16 700-N17
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	115-125V dc 115-125V dc	700-N11 700-N14
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	230-250V dc 230-250V dc	700-N12 700-N15
Bulletin 700 Type N, P, or PK Relay	150V max, ac or DC	700-N24
Miscellaneous electromagnetic devices limited to 35 sealed VA	150V max, ac or DC	700-N24

Grounding the Controller

In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the base unit to the electrical panel's ground bus prior to connecting any devices. Use AWG #14 wire. This connection must be made for safety purposes.

This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the *Industrial Automation Wiring and Grounding Guidelines*, publication 1770-4.1, for additional information. Additional grounding connections from the mounting tab or DIN rail, if used, are not required unless the mounting surface cannot be grounded.

NOTE It is recommended to use all four mounting positions for panel mounting installation.



ATTENTION Remove the protective debris strip before applying power to the controller. Failure to remove the strip may cause the controller to overheat.

Wiring Diagrams

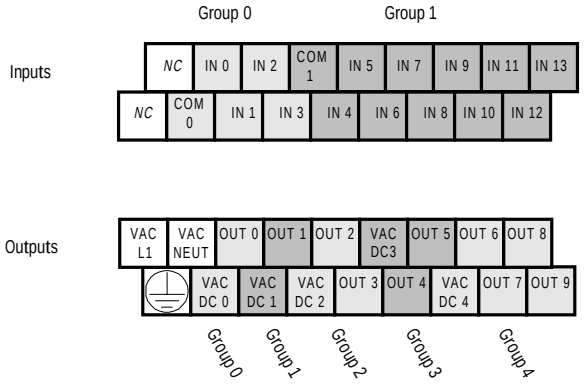
The following illustrations show the wiring diagrams for the MicroLogix 1200 controllers. Controllers with dc inputs can be wired as either sinking or sourcing inputs. (Sinking and sourcing does not apply to ac inputs.) Refer to Sinking and Sourcing Wiring Diagrams on page 3-10

The controller terminal block layouts are shown below. The shading on the labels indicates how the terminals are grouped. A detail of the groupings is shown in the table following the terminal block layouts.

NOTE This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes.

Terminal Block Layouts

Figure 3.1 1762-L24AWA



ATTENTION

The 24V dc user supply of the 1762-L24BWA should not be used to power output circuits. It should only be used to power input devices (e.g. sensors, switches). Refer to Master Control Relay on page 2-8 for information on MCR wiring in output circuits.

Figure 3.2 1762-L24BWA

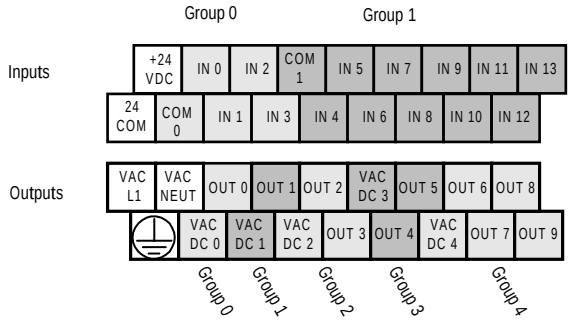


Figure 3.3 1762-L40AWA

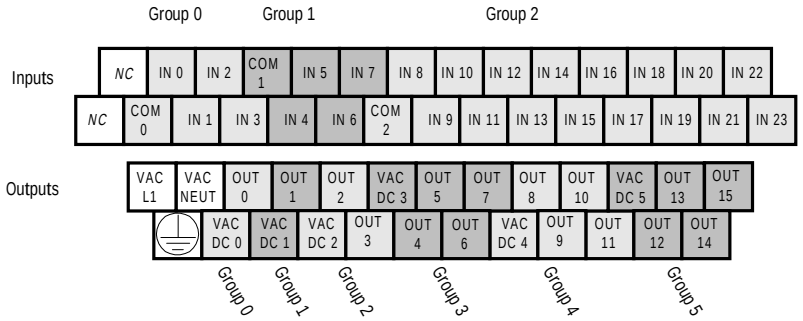
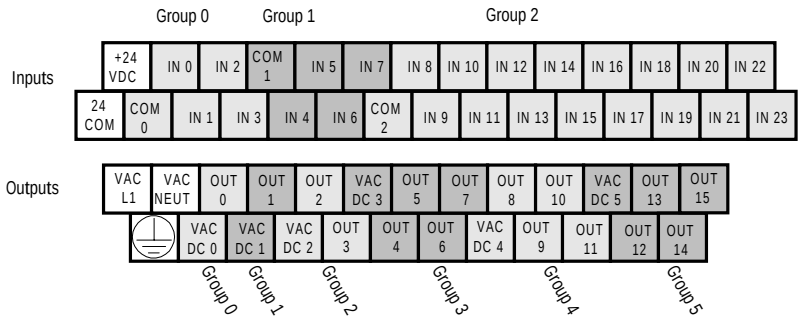


Figure 3.4 1762-L40BWA



Terminal Groupings

Table 3.3 Input Terminal Grouping

Controller	Inputs		
	Input Group	Common Terminal	Input Terminal
1762-L24BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/13
1762-L24AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/13
1762-L40BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/23
1762-L40AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/7
	Group 2	AC COM 2	I/8 through I/23

Table 3.4 Output Terminal Grouping

Controller	Outputs		
	Output Group	Voltage Terminal	Output Terminal
1762-L24BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/5
	Group 4	VAC/VDC 4	O/6 through O/9
1762-L24AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O4 through O/5
	Group 4	VAC/VDC 4	O/6 through O/9
1762-L40BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/7
	Group 4	VAC/VDC 4	O/8 through O/11
	Group 5	VAC/VDC 5	O/12 through O/15
1762-L40AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/7
	Group 4	VAC/VDC 4	O/8 through O/11
	Group 5	VAC/VDC 5	O/12 through O/15

Sinking and Sourcing Wiring Diagrams

Any of the MicroLogix 1200 DC embedded input groups can be configured as sinking or sourcing depending on how the DC COM is wired on the group. Refer to pages 3-11 through 3-13 for sinking and sourcing wiring diagrams.

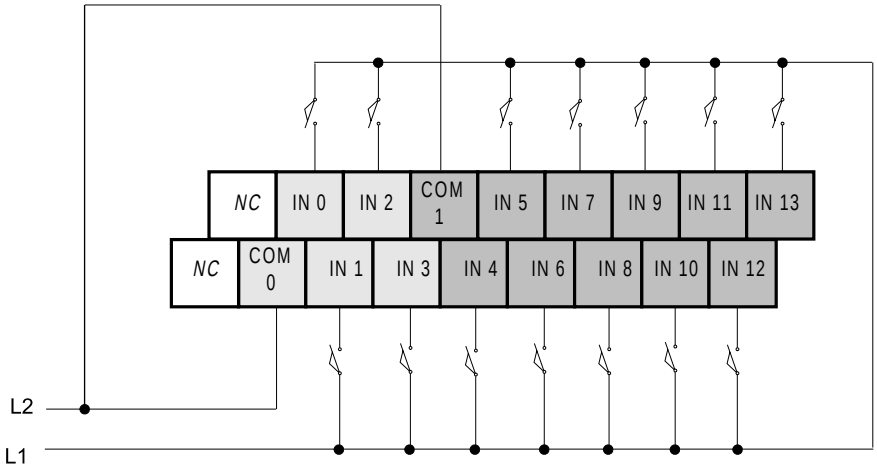
Type	Definition
Sinking Input	The input energizes when high-level voltage is applied to the input terminal (active high). Connect the power supply VDC (-) to the DC COM terminal.
Sourcing Input	The input energizes when low-level voltage is applied to the input terminal (active low). Connect the power supply VDC (+) to the DC COM terminal.

ATTENTION

The 24V dc user power source must not be used to power output circuits. It should only be used to power input devices (e.g. sensors, switches). Refer to Master Control Relay on page 2-8 for information on MCR wiring in output circuits.

1762-L24AWA and 1762-L24BWA Wiring Diagrams

Figure 3.5 1762-L24AWA Input Wiring Diagram(1)



(1) "NC" terminals are not intended for use as connection points.

Figure 3.6 1762-L24BWA Sinking Input Wiring Diagram

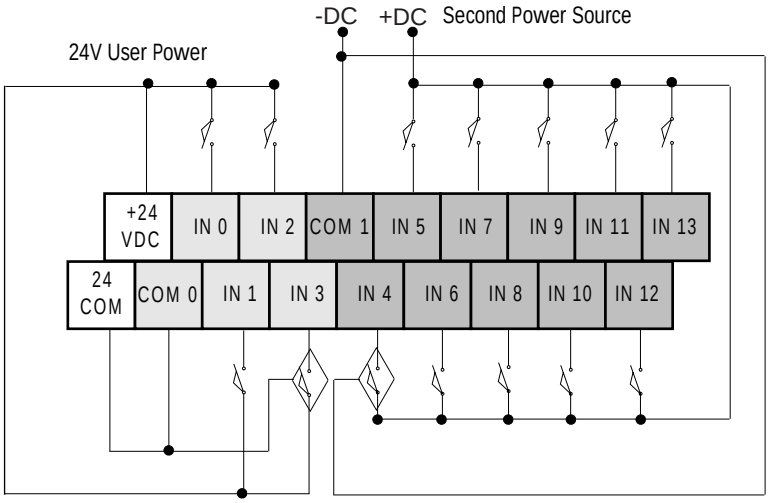


Figure 3.7 1762-L24BWA Sourcing Input Wiring Diagram

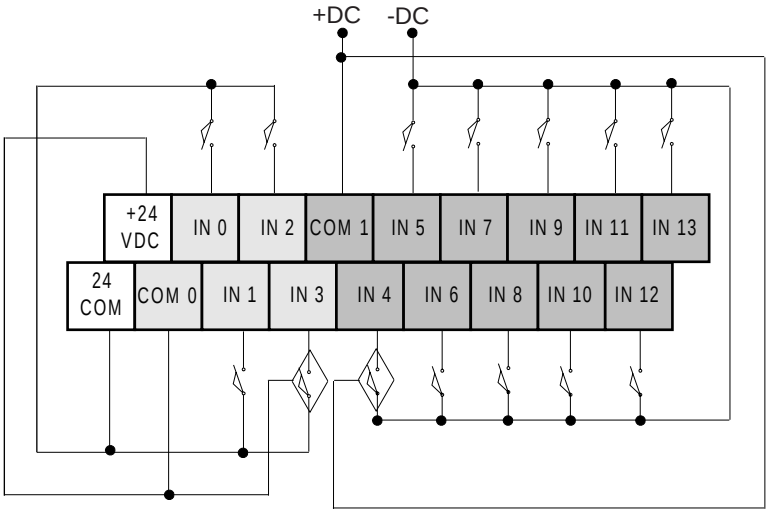
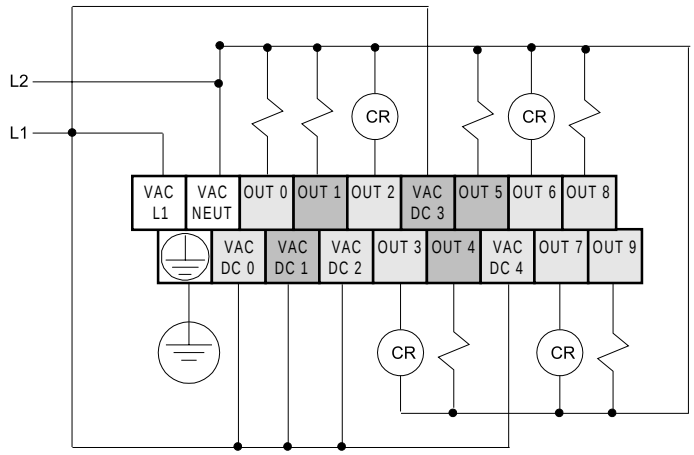


Figure 3.8 1762-L24AWA and 1762-L24BWA Output Wiring Diagram



1762-L40AWA and 1762-L40BWA Wiring Diagrams

Figure 3.9 1762-40AWA Input Wiring Diagram

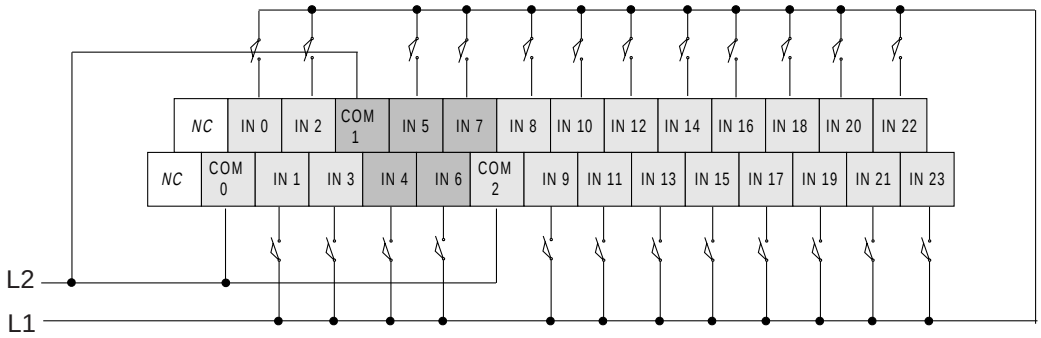


Figure 3.10 1762-L40BWA Sinking Input Wiring Diagram

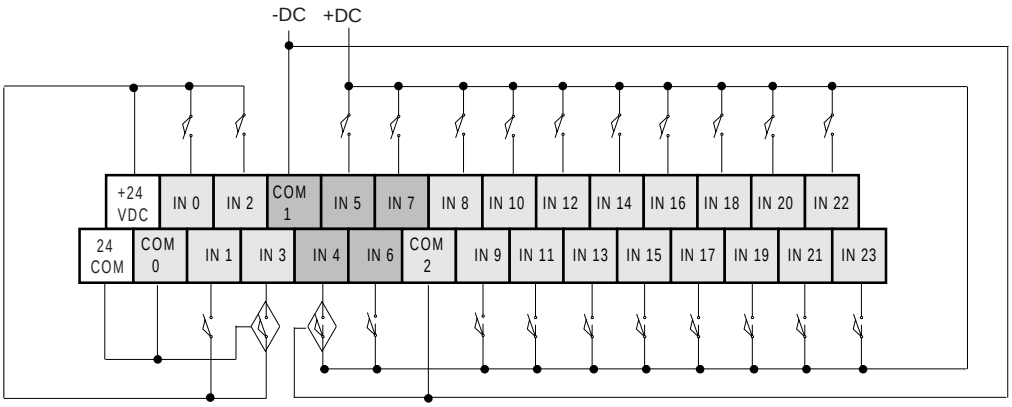


Figure 3.11 1762-L40BWA Sourcing Input Wiring Diagram

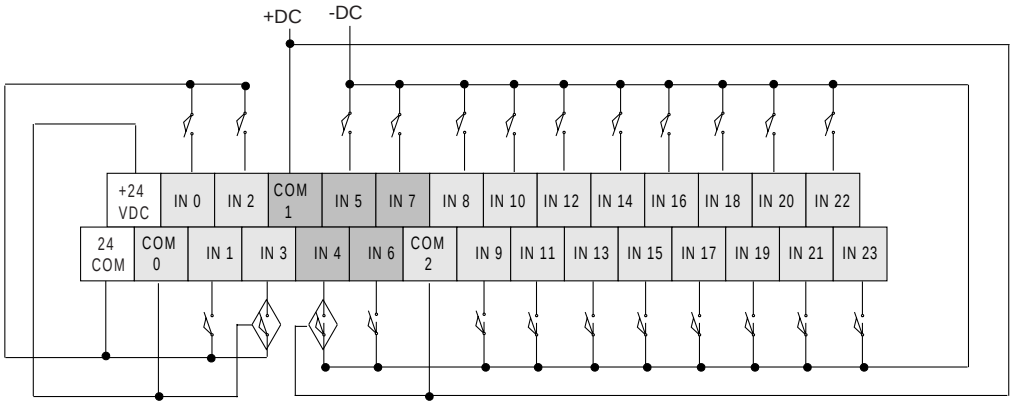
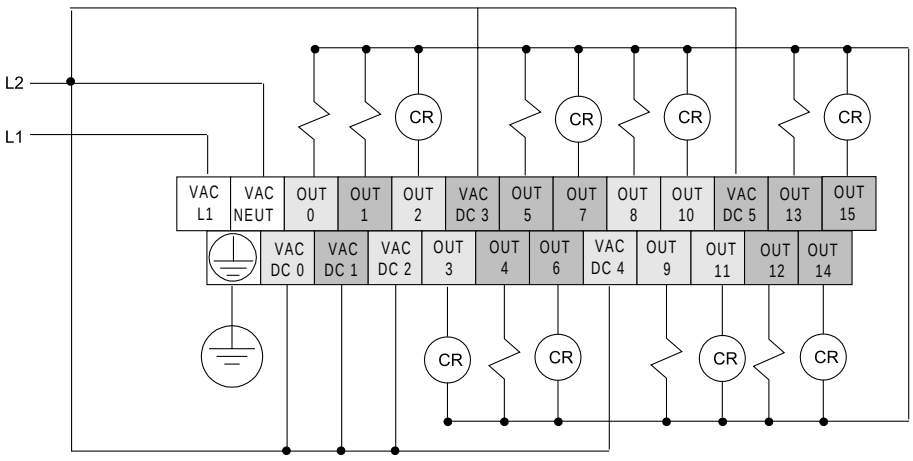


Figure 3.12 1762-L40AWA and 1762-L40BWA Output Wiring Diagram



Controller I/O Wiring

Minimizing Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the MicroLogix 1200 system in a properly rated (i.e. NEMA) enclosure. Make sure that the MicroLogix 1200 system is properly grounded.

A system may malfunction due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micrologix 1200 system.

Expansion I/O Wiring

Discrete Wiring Diagrams

The following illustrations show the discrete expansion I/O wiring diagrams.

Figure 3.13 1762-IA8 Wiring Diagram

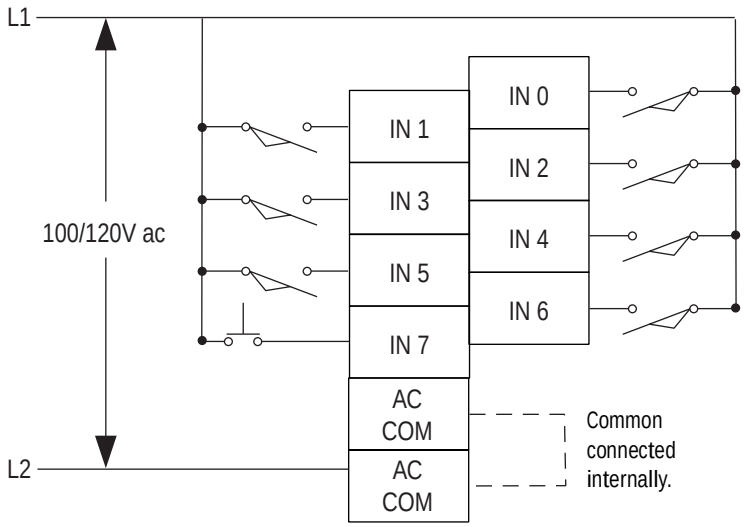


Figure 3.14 1762-IQ8 Wiring Diagram

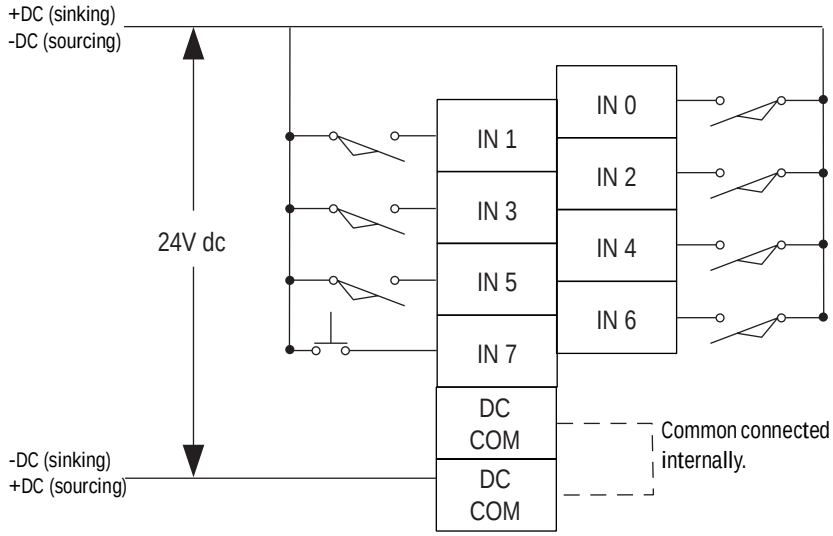
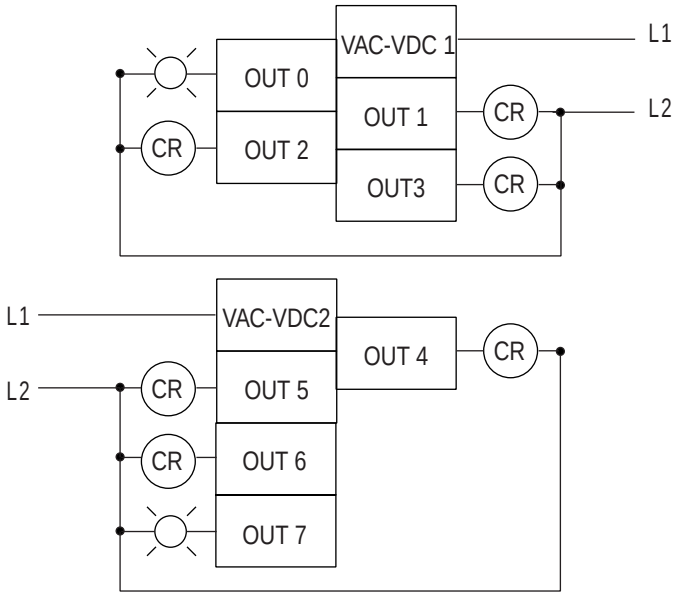


Figure 3.15 1762-OW8 Wiring Diagram



Analog Wiring Diagrams

1762-IF2OF2 Wiring

The following illustrations show the analog expansion I/O wiring diagrams.

Figure 3.16 1762-IF2OF2 Terminal Block Layout

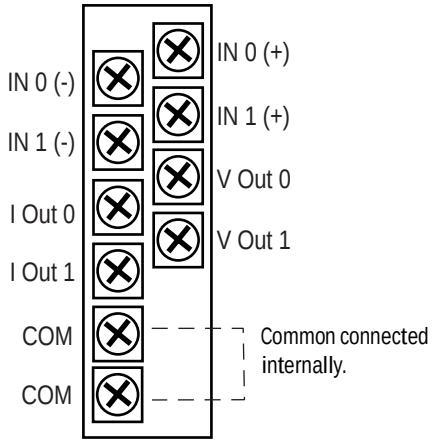


Figure 3.17 Differential Sensor Transmitter Types

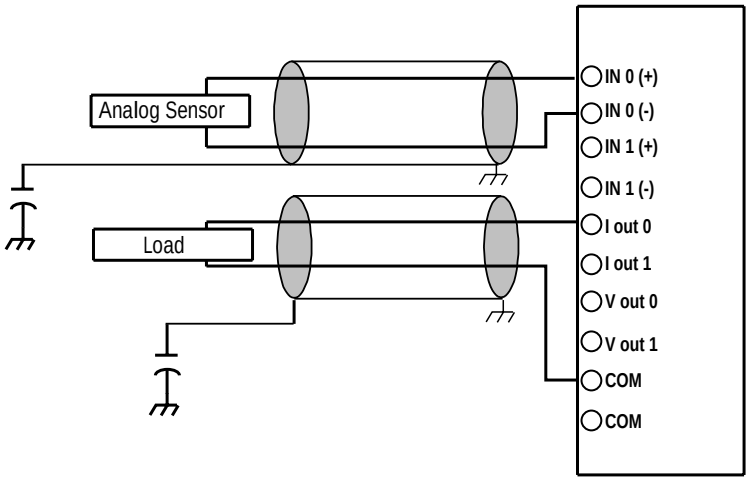
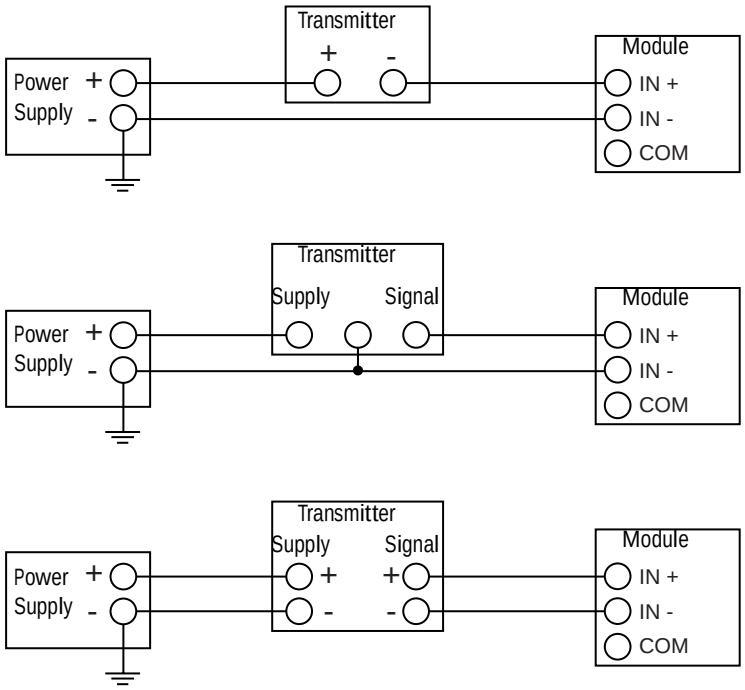


Figure 3.18 Single-ended Sensor/Transmitter Types



Communication Connections

This chapter describes how to communicate to your control system. The method you use and cabling required to connect your controller depends on what type of system you are employing. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

- default communication configurations
- using communications toggle push button
- connecting to RS-232 port
- connecting to DH485 network
- connecting to AIC+
- DeviceNet communications

Default Communication Configuration

The MicroLogix 1200 has the following default communication configuration.

NOTE

The default configuration is present when:

- The controller is powered-up for the first time.
- The communications toggle push button specifies default communications (the DCOMM LED is on).
- An OS upgrade is completed.

Refer to Understanding the Communication Protocols on page E-1 for more information about communicating.

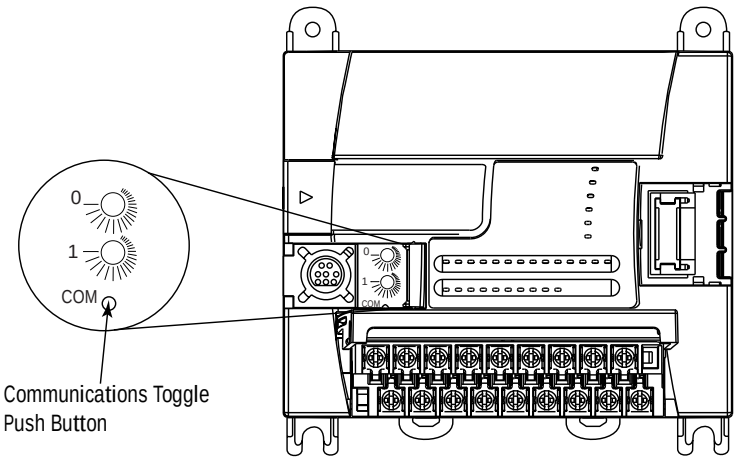
Table 4.1 DF1 Full-Duplex Default Configuration Parameters

Parameter	Default
Baud Rate	19.2K
Parity	none
Source ID (Node Address)	1
Control Line	no handshaking
Stop Bits	1

Using the Communications Toggle Push Button

The Communications Toggle Push Button is located on the processor under the processor door (if installed), as shown below.

Use the Communications Toggle Push Button to change from the user-defined communication configuration to the default communications mode and back. The Default Communications (DCOMM) LED operates to show when the controller is in the default communications mode (settings shown on page 4-1).



NOTE The Communication Toggle Push Button must be pressed and held for one second to activate.

Connecting to the RS-232 Port

There are two ways to connect the MicroLogix 1200 programmable controller to your personal computer using the DF1 protocol: using a point-to-point connection, or using a modem. Descriptions of these methods follow.

ATTENTION

Chassis ground, internal 24V dc ground, user 24V dc ground, and RS-232 ground are internally connected. You must connect the chassis ground terminal screw to chassis ground prior to connecting any devices. It is important that you understand your personal computer's grounding system before connecting to the controller. An optical isolator is recommended between the controller and your personal computer.

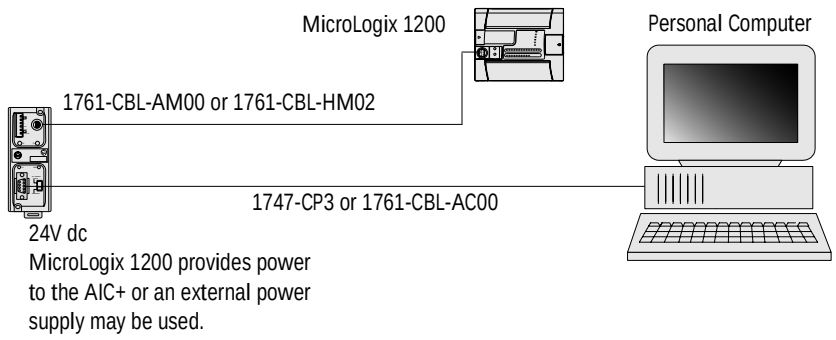
Table 4.2 Available Communication Cables

Communication Cables	Length
1761-CBL-PM02 Series C or later	2m (6.5 ft)
1761-CBL-HM02 Series C or later	2m (6.5 ft)
1761-CBL-AM00 Series C or later	45 cm (17.7 in)
1761-CBL-AP00 Series C or later	45 cm (17.7 in)
2707-NC8 Series B or later	2m (6.5 ft)
2707-NC9 Series B or later	15m (49.2 ft)
2707-NC10 Series B or later	2m (6.5 ft)
2707-NC11 Series B or later	2m (6.5 ft)

Making a DF1 Point-to-Point Connection

You can connect the MicroLogix 1200 programmable controller to your personal computer using a serial cable (1762-CBL-PM02) from your personal computer's serial port to the controller, as shown below. The recommended protocol for this configuration is DF1 Full-Duplex.

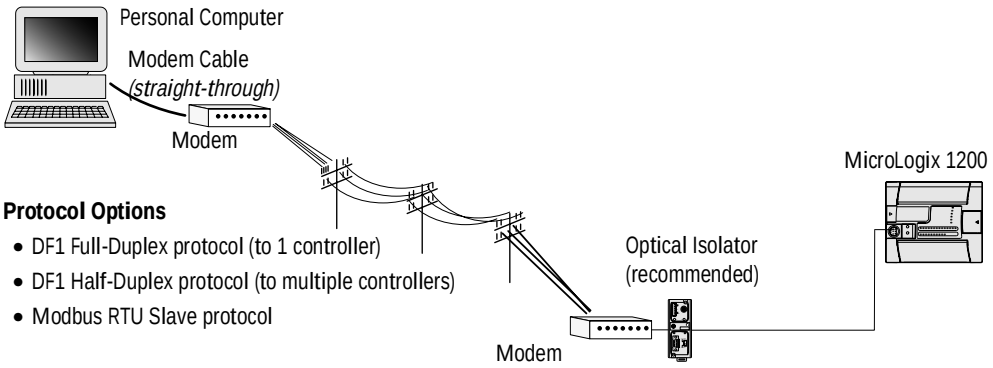
We recommend using an Advanced Interface Converter (AIC+), catalog number 1761-NET-AIC, as your optical isolator, as shown below.
See page 4-11 for specific AIC+ cabling information.



NOTE Series C or higher cables are required.

Using a Modem

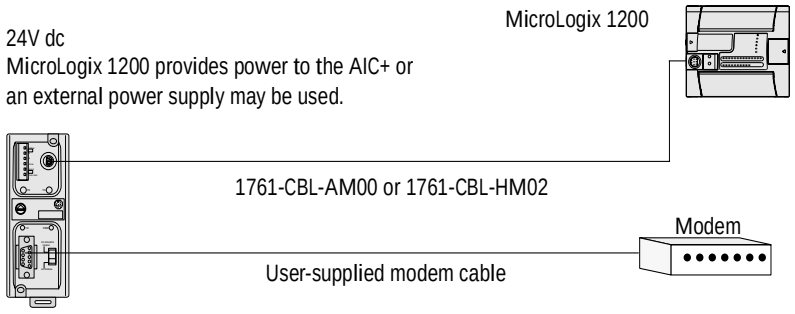
You can use modems to connect a personal computer to one MicroLogix 1200 controller (using DF1 Full-Duplex protocol), to multiple controllers (using DF1 Half-Duplex protocol), or Modbus RTU Slave protocol, as shown in the following illustration. Do not attempt to use DH485 protocol through modems under any circumstance. (Refer to Understanding the Communication Protocols on page E-1 for information on types of modems you can use with the micro controllers.)



We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator. See page 4-11 for specific AIC+ cabling information.

Isolated Modem Connection

Using an AIC+ to isolate the modem is illustrated below.

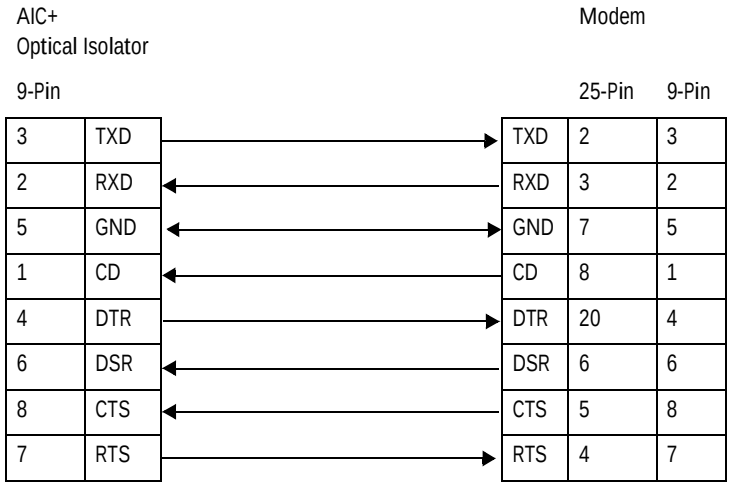


For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

NOTE Series C or higher cables are required.

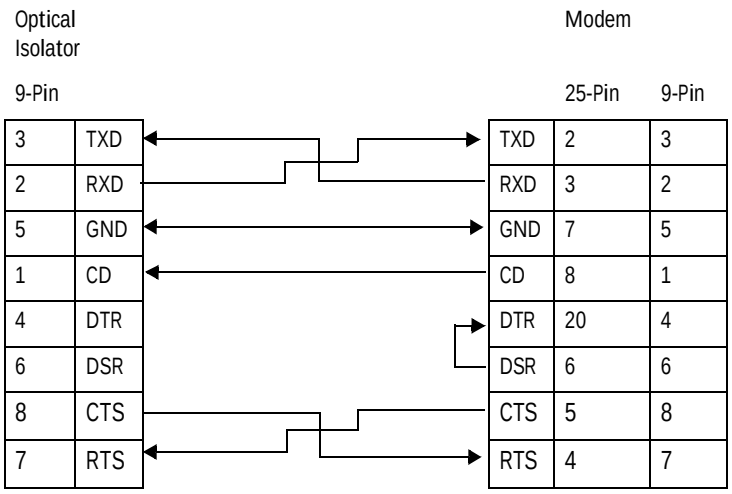
Constructing Your Own Modem Cable

If you construct your own modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a *straight-through* cable:



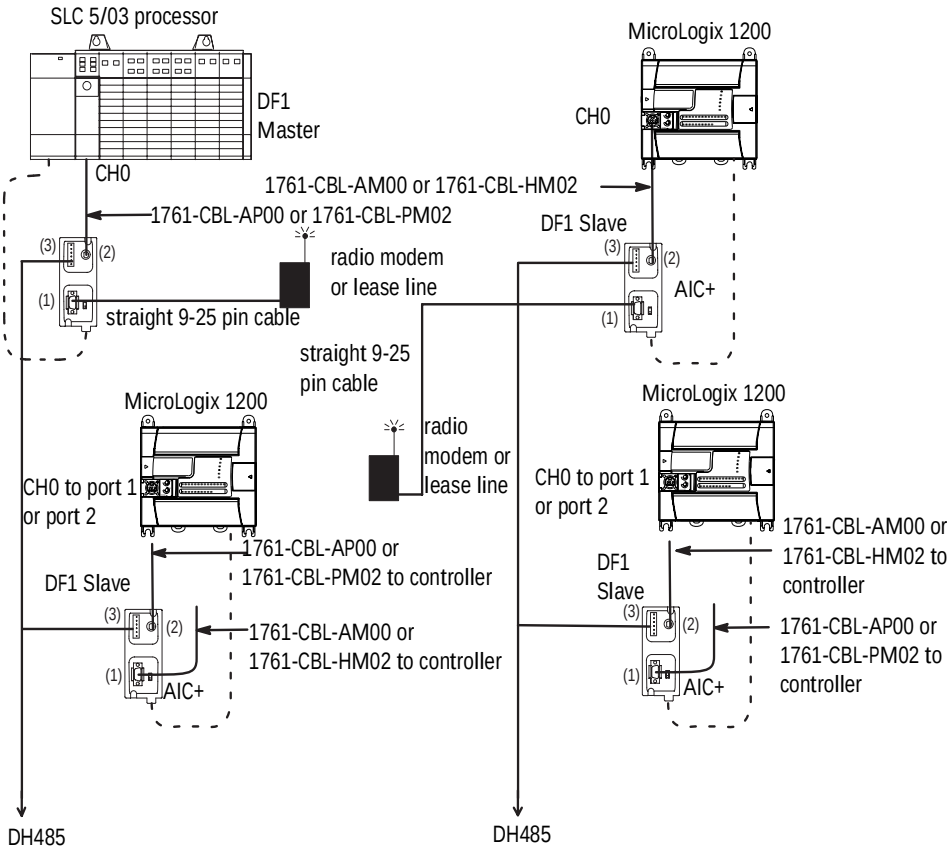
Constructing Your Own Null Modem Cable

If you construct your own null modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout:



Connecting to a DF1 Half-Duplex Network

Use this diagram for DF1 Half-Duplex Master-Slave protocol without hardware handshaking.



NOTE Series C or higher cables are required.

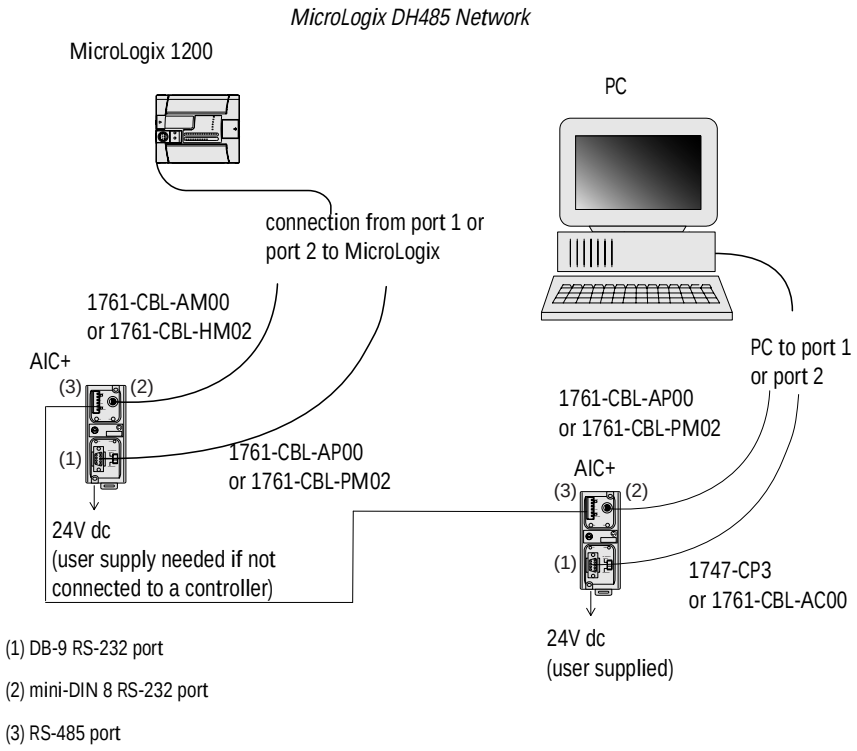
(1) DB-9 RS-232 port

(2) mini-DIN 8 RS-232 port

(3) RS-485 port

Connecting to a DH485 Network

The following illustration shows how to connect to a DH485 network.



NOTE Series C or higher cables are required.

Recommended Tools

To connect a DH485 network, you need tools to strip the shielded cable and to attach the cable to the AIC+ Advanced Interface Converter. We recommend the following equipment (or equivalent):

Table 4.3 Working with Cable for DH485 Network

Description	Part Number	Manufacturer
Shielded Twisted Pair Cable	#3106A or #9842	Belden
Stripping Tool	45-164	Ideal Industries
1/8” Slotted Screwdriver	Not Applicable	Not Applicable

DH485 Communication Cable

The suggested DH485 communication cable is either Belden #3106A or #9842. The cable is jacketed and shielded with one or two twisted-wire pairs and a drain wire.

One pair provides a balanced signal line and one additional wire is used for a common reference line between all nodes on the network. The shield reduces the effect of electrostatic noise from the industrial environment on network communication.

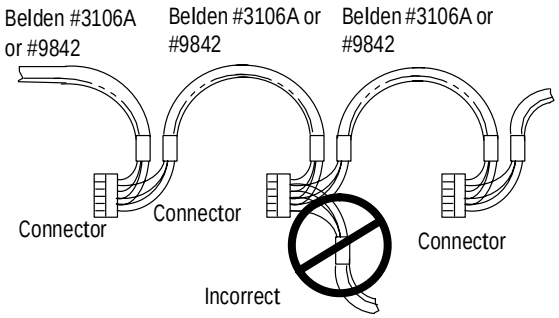
The communication cable consists of a number of cable segments daisy-chained together. The total length of the cable segments cannot exceed 1219 m (4000 ft). However, two segments can be used to extend the DH485 network to 2438 m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

When cutting cable segments, make them long enough to route them from one AIC+ to the next, with sufficient slack to prevent strain on the connector. Allow enough extra cable to prevent chafing and kinking in the cable.

Use these instructions for wiring the Belden #3106A or #9842 cable. (Refer to Cable Selection Guide on page 4-11 if you are using standard Allen-Bradley cables.)

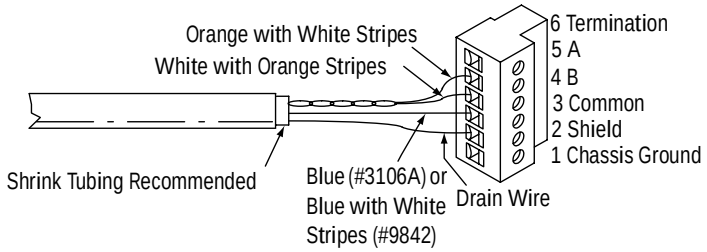
Connecting the Communication Cable to the DH485 Connector

NOTE A daisy-chained network is recommended. Do *not* make the incorrect connection shown below:



Single Cable Connection

When connecting a single cable to the DH485 connector, use the following diagram.



Multiple Cable Connection

When connecting multiple cables to the DH485 connector, use the following diagram.

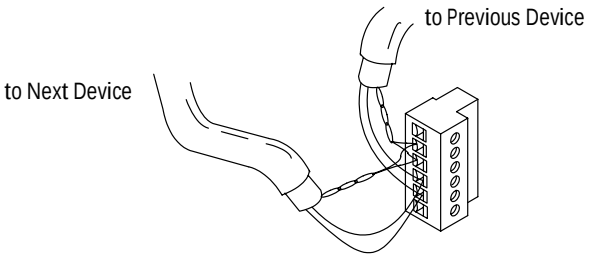


Table 4.4 Connections using Belden #3106A Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue	Blue	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

Table 4.5 Connections using Belden #9842 Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue/White	White with Blue Stripe	Cut back - no connection(1)
	Blue with White Stripe	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

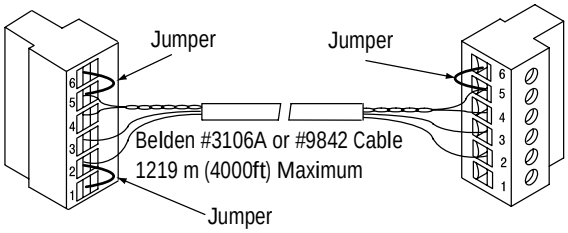
(1) To prevent confusion when installing the communication cable, cut back the white with blue stripe wire immediately after the insulation jacket is removed. This wire is not used by DH485.

Grounding and Terminating the DH485 Network

Only one connector at the end of the link must have Terminals 1 and 2 jumpered together. This provides an earth ground connection for the shield of the communication cable.

Both ends of the network must have Terminals 5 and 6 jumpered together, as shown below. This connects the termination impedance (of 120Ω) that is built into each AIC+ as required by the DH485 specification.

End-of-Line Termination



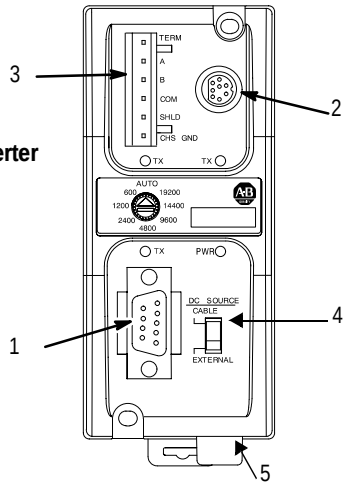
Connecting the AIC+

The AIC+, catalog number 1761-NET-AIC, enables a MicroLogix 1200 to connect to a DH485 network. The AIC+ has two RS-232 ports and one isolated RS-485 port. Typically, there is one AIC+ for each MicroLogix 1200. When two MicroLogix controllers are closely positioned, you can connect a controller to each of the RS-232 ports on the AIC+.

The AIC+ can also be used as an RS-232 isolator, providing an isolation barrier between the MicroLogix 1200 communications port and any equipment connected to it (i.e. personal computer, modem, etc.).

The following figure shows the external wiring connections and specifications of the AIC+.

AIC+ Advanced Interface Converter (1761-NET-AIC)



Item	Description
1	Port 1 - DB-9 RS-232, DTE
2	Port 2 - mini-DIN 8 RS-232 DTE
3	Port 3 - RS-485 Phoenix plug
4	DC Power Source selector switch (cable = port 2 power source, external = external power source connected to item 5)
5	Terminals for external 24V dc power supply and chassis ground

For additional information on connecting the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

Cable Selection Guide

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1761-CBL-AP00(2) 1761-CBL-PM02(2)	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, ch 0	port 2	yes	external
		MicroLogix 1000, 1200, or 1500	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 2	yes	external
		DTAM Plus / DTAM Micro	port 2	yes	external
		PC COM port	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

(2) Series C or higher cables are required.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting
1761-CBL-AM00(2) 1761-CBL-HM02(2)	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000, 1200, or 1500	port 2	no	cable
		to port 2 on another AIC+	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

(2) Series C or higher cables are required.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1747-CP3 1761-CBL-AC00(1)	3m (9.8 ft) 45 cm (17.7 in)	SLC 5/03 or SLC 5/04 processor, channel 0	port 1	yes	external
		PC COM port	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 1	yes	external
		DTAM Plus / DTAM Micro™	port 1	yes	external
		Port 1 on another AIC+	port 1	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

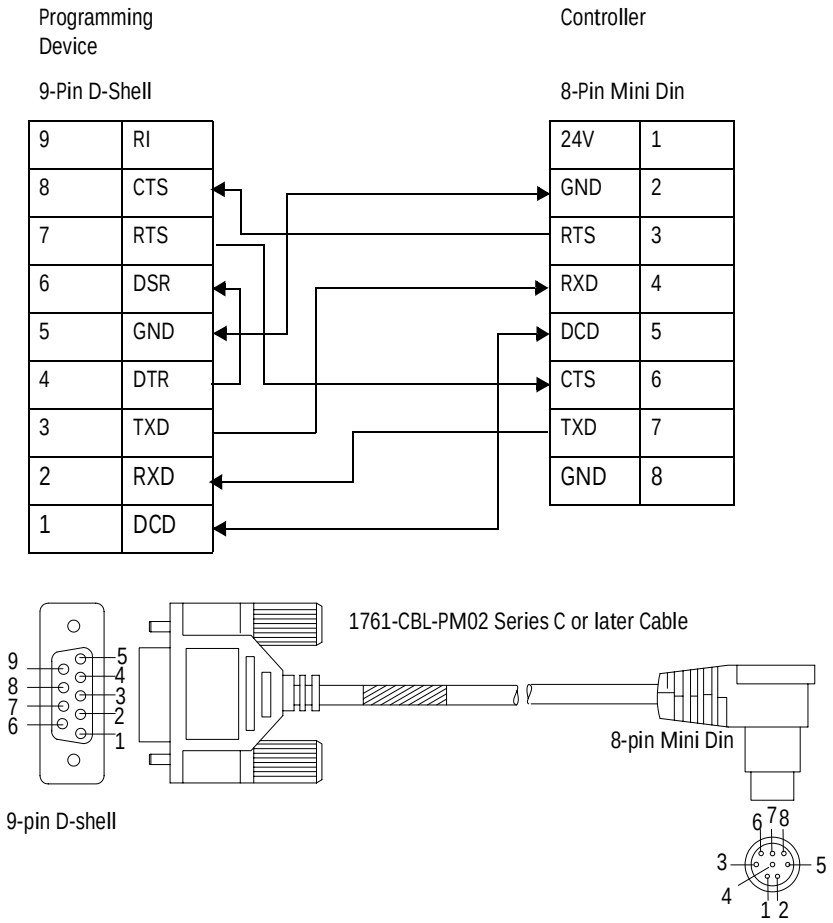
Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
straight 9-25 pin	—	modem or other communication device	port 1	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1761-CBL-AS03 1761-CBL-AS09	3m (9.8 ft) 9.5m (31.17 ft)	SLC 500 Fixed, SLC 5/01, SLC 5/02, and SLC 5/03 processors	port 3	yes	external
		PanelView 550 RJ45 port	port 3	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

1761-CBL-PM02 Series C (or equivalent) Cable Wiring Diagram



Recommended User-Supplied Components

These components can be purchased from your local electronics supplier.

Table 4.6 User Supplied Components

Component	Recommended Model
external power supply and chassis ground	power supply rated for 20.4 to 28.8V dc
NULL modem adapter	standard AT
straight 9-25 pin RS-232 cable	see table below for port information if making own cables

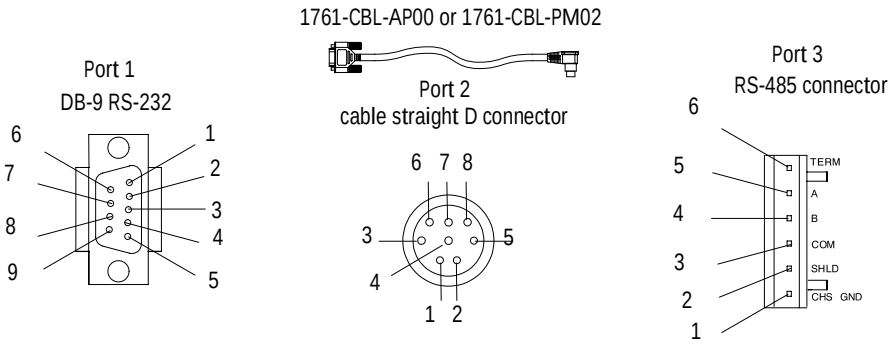


Table 4.7 AIC+ Terminals

Pin	Port 1: DB-9 RS-232	Port 2[2]: (1761-CBL-PM02 cable)	Port 3: RS-485 Connector
1	received line signal detector (DCD)	24V dc	chassis ground
2	received data (RxD)	ground (GND)	cable shield
3	transmitted data (TxD)	request to send (RTS)	signal ground
4	DTE ready (DTR)[1]	received data (RxD)[3]	DH485 data B
5	signal common (GND)	received line signal detector (DCD)	DH485 data A
6	DCE ready (DSR)[2]	clear to send (CTS)[3]	termination
7	request to send (RTS)	transmitted data (TxD)	not applicable
8	clear to send (CTS)	ground (GND)	not applicable
9	not applicable	not applicable	not applicable

(1) On port 1, pin 4 is electronically jumpered to pin 6. Whenever the AIC+ is powered on, pin 4 will match the state of pin 6.

(2) An 8-pin mini DIN connector is used for making connections to port 2. This connector is not commercially available. If you are making a cable to connect to port 2, you must configure your cable to connect to the Allen-Bradley cable shown above.

(3) In the 1761-CBL-PM02 cable, pins 4 and 6 are jumpered together within the DB-9 connector.

Safety Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

WARNING

EXPLOSION HAZARD - AIC+ must be operated from an external power source.

This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.

Refer to Safety Considerations on page 2-4 for additional information.

Installing and Attaching the AIC+

1. Take care when installing the AIC+ in an enclosure so that the cable connecting the MicroLogix 1200 controller to the AIC+ does not interfere with the enclosure door.

2. Carefully plug the terminal block into the RS-485 port on the AIC+ you are putting on the network. Allow enough cable slack to prevent stress on the plug.

3. Provide strain relief for the Belden cable after it is wired to the terminal block. This guards against breakage of the Belden cable wires.

Powering the AIC+

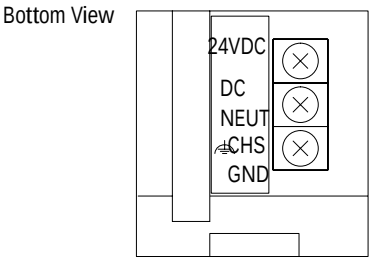
In normal operation with the MicroLogix 1200 programmable controller connected to port 2 of the AIC+, the controller powers the AIC+. Any AIC+ not connected to a controller requires a 24V dc power supply. The AIC+ requires 120 mA at 24V dc.

If both the controller and external power are connected to the AIC+, the power selection switch determines what device powers the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc. Permanent damage results if a higher voltage supply is used.

Set the DC Power Source selector switch to EXTERNAL before connecting the power supply to the AIC+. The following illustration shows where to connect external power for the AIC+.



ATTENTION

Always connect the CHS GND (chassis ground) terminal to the nearest earth ground. This connection must be made whether or not an external 24V dc supply is used.

Power Options

Below are two options for powering the AIC+:

- Use the 24V dc user power supply built into the MicroLogix 1200 controller. The AIC+ is powered through a hard-wired connection using a communication cable (1761-CBL-HM02, or equivalent) connected to port 2.
- Use an external DC power supply with the following specifications:
  - operating voltage: 24V dc +20% or -15%
  - output current: 150 mA minimum
  - rated NEC Class 2

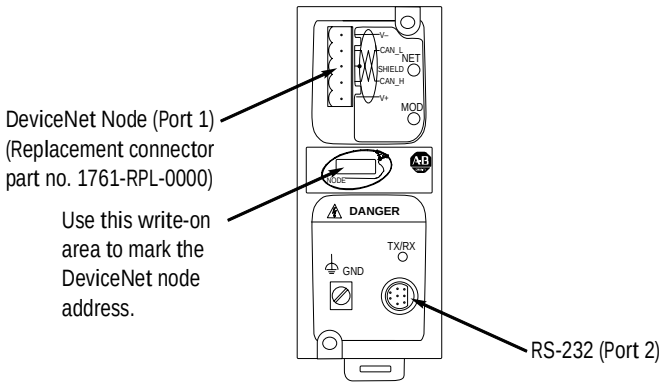
Make a hard-wired connection from the external supply to the screw terminals on the bottom of the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc. Permanent damage results if miswired with the wrong power source.

DeviceNet Communications

You can connect a MicroLogix 1200 to a DeviceNet network using the DeviceNet Interface (DNI), catalog number 1761-NET-DNI. For additional information on using the DNI, refer to the *DeviceNet Interface User Manual*, publication 1761-6.5. The following figure shows the external wiring connections of the DNI.



Cable Selection Guide(1)

Cable	Length	Connections from	to DNI
1761-CBL-AM00 1761-CBL-HM02	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000	port 2
		MicroLogix 1200	port 2

Cable	Length	Connections from	to DNI
1761-CBL-AP00 1761-CBL-PM02	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, channel 0	port 2
		PC COM port	port 2

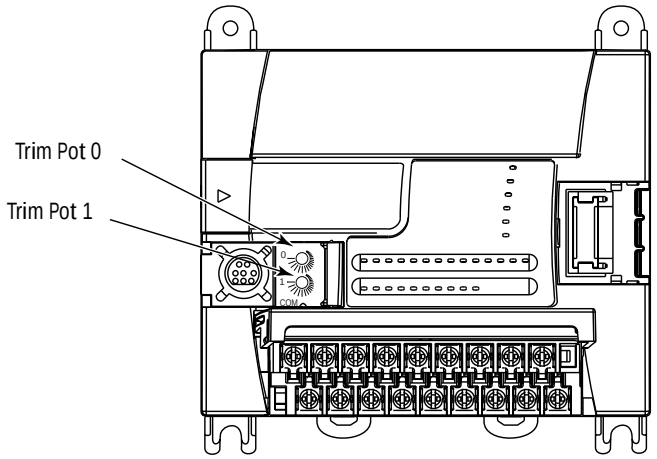
(1) Series C (or higher) cables are required.

Using Trim Pots

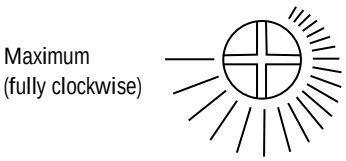
Trim Pot Operation

The processor has two trimming potentiometers (trim pots) which allow modification of data within the controller. Adjustments to the trim pots change the value in the corresponding Trim Pot Information (TPI) register. The data value of each trim pot can be used throughout the control program as timer, counter, or analog presets depending upon the requirements of the application.

The trim pots are located below the memory module port cover and to the right of the communications port, as shown below.



Use a small flathead screwdriver to turn the trim pots. Adjusting their value causes data to change within a range of 0 to 250 (fully clockwise). The maximum rotation of each trim pot is three-quarters, as shown below. Trim pot stability over time and temperature is typically ±2 counts.



Trim pot file data is updated continuously whenever the controller is powered-up.

Trim Pot Information Function File

The composition of the Trim Pot Information (TPI) Function File is described in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P.

Error Conditions

Error conditions of the TPI Function File are described in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P.

Using Real-Time Clock and Memory Modules

NOTE For more information on "Real-Time Clock Function File" and "Memory Module Information File" please refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P.

Three modules with different levels of functionality are available for use with the MicroLogix 1200 controller.

Catalog Number	Function
1762-RTC	Real-Time Clock
1762-MM1	Memory Module
1762-MM1RTC	Memory Module and Real-Time Clock

Real-Time Clock Operation

Removal/Insertion Under Power

At power-up and when the controller enters a run or test mode, the controller determines if a real-time clock module (RTC) is present. If an RTC is present, its values (date, time and status) are written to the RTC Function File in the controller.

The RTC module can be installed or removed at any time without risk of damage to either the module or the controller. If an RTC is installed while the MicroLogix 1200 is in a run or test mode, the module is not recognized until either a power cycle occurs or until the controller is placed in a non-executing mode (program mode, suspend mode or fault condition).

Removal of the RTC during run mode is detected within one program scan. Removal of the RTC while in run mode causes the controller to write zeros to the RTC Function File.

The following table indicates the accuracy of the RTC for various temperatures.

Table 6.1 RTC Accuracy

Ambient Temperature	Accuracy(1)
0°C (+32°F)	+34 to -70 seconds/month
+25°C (+77°F)	+36 to -68 seconds/month
+40°C (+104°F)	+29 to -75 seconds/month
+55°C (+131°F)	-133 to -237 seconds/month

(1) These numbers are maximum worst case values over a 31-day month.

Writing Data to the Real-Time Clock

When valid data is sent to the real-time clock from the programming device or another controller, the new values take effect immediately.

The real-time clock does not recognize or accept invalid date or time data.

Use the *Disable Clock* button in your RSLogix programming software to disable the real-time clock before storing a module. This decreases the drain on the RTC battery during storage.

RTC Battery Operation

The real-time clock has an internal battery that is not replaceable. The RTC Function File features a battery low indicator bit (RTC:0/BL), which shows the status of the RTC battery. When the battery is low, the indicator bit is set (1). This means that the battery may fail within 14 days and the real-time clock module needs to be replaced. When the battery low indicator bit is clear (0), the battery level is acceptable or a real-time clock is not attached.

If the RTC battery is low and the controller is powered, the RTC operates normally. If the controller power is removed and the RTC battery is low, RTC data is lost.

Table 6.2 RTC Battery Life Span

Life Span	Operating Temperature	Storage Temperature(1)
5 years	+0°C to +40°C (+32°F to +104°F)	-40°C to +60°C (-40°F to +140°F)

(1) Stored for six months.

ATTENTION

Operating with a low battery indication for more than 14 days may result in invalid RTC data unless power is on continuously.

Memory Module Operation

The memory module supports program back-up as well as the following features:

- User Program and Data Back-up
- User Program Compare
- Data File Download Protection
- Memory Module Write Protection
- Removal/Insertion Under Power

ATTENTION

Electrostatic discharge can damage the Memory Module. Do not touch the connector pins or other sensitive areas.

User Program and Data Back-up

The memory module provides a simple and flexible program/data transport mechanism, allowing the user to transfer the program and data to the controller without the use of a personal computer and programming software.

The memory module can store one user program at a time.

During program transfers to or from the memory module, the controller's RUN LED flashes.

Program Compare

The memory module can also provide application security, allowing you to specify that if the program stored in the memory module does not match the program in the controller, the controller will not enter an executing (run or test) mode. To enable this feature, set the S:2/9 bit in the system status file. See "Status System File" in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001A-US-P for more information.

Data File Download Protection

The memory module allows the user to specify individual data files in the controller that are protected from the download procedure. This allows user data to be saved (not overwritten) during a download.

NOTE Data file download protection is only functional if the processor does not have a fault and if the size of the protected data file structures of the memory module exactly matches the size of the protected data file structure within the controller. See "Protecting Data Files During Download" in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001A-US-P.

Memory Module Write Protection

The memory module supports write-once, read-many behavior. Write protection is enabled using your programming software.

IMPORTANT Once set, write protection cannot be removed. A change cannot be made to the control program stored in a write protected memory module. If a change is required, use a different memory module.

Removal/Insertion Under Power

The memory module can be installed or removed at any time without risk of damage to either the memory module or the controller. If a memory module is installed while the MicroLogix 1200 is executing, the memory module is not recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode, suspend mode or fault condition).

Specifications

Table A.1 General Specifications

Description	1762-L24AWA	1762-L24BWA	1762-L40AWA	1762-L40BWA
Dimensions	Height: 90 mm (3.55 in) 104 mm (4.10 in) (with DIN latch open) Width: 110 mm (4.33 in) Depth: 87 mm (3.43 in)		Height: 90 mm (3.55 in) 104 mm (4.10 in) (with DIN latch open) Width: 160 mm (6.30 in) Depth: 87 mm (3.43 in)	
Shipping Weight	0.9 kg (2.0 lb)		1.1 kg (2.4 lb)	
Number of I/O	14 inputs 10 outputs	14 inputs 10 outputs	24 inputs 16 outputs	24 inputs 16 outputs
Line Power	85 to 265V ac at 47 to 63 Hz	85 to 265V ac at 47 to 63 Hz	85 to 265V ac at 47 to 63 Hz	85 to 265V ac at 47 to 63 Hz
Power Supply Nominal	100/120V ac 200/240 V ac			
Power Supply Usage	68 VA	70 VA	80 VA	82 VA
Power Supply Inrush	120V ac = 25A for 8 ms 240V ac = 40A for 4 ms			
Heat Dissipation	Refer to Calculating Heat Dissipation on page F-9			
Power Supply Output	400 mA at 5V 350 mA at 24V	400 mA at 5V(1) 350 mA at 24V(1)	600 mA at 5V 500 mA at 24V	600 mA at 5V(2) 500 mA at 24V(2)
User Power Output	none	24V dc at 250 mA(1) 400 µF max.	none	24V dc at 400 mA(2) 400 µF max.
Input Circuit Type	120V ac	24V dc sink/source	120V ac	24V dc sink/source
Output Circuit Type	Relay	Relay	Relay	Relay
Operating Temperature	+0°C to +55°C (+32°F to +131°F) ambient			
Storage Temperature	-40°C to +85°C (-40°F to +185°F) ambient			
Operating Humidity	5% to 95% relative humidity (non-condensing)			
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak, Relay Operation: 1.5G			

Table A.1 General Specifications

Description	1762-L24AWA	1762-L24BWA	1762-L40AWA	1762-L40BWA
Shock	Operating: 30G Relay Operation: 7G Non-Operating: 50G panel mounted (40G DIN Rail mounted)			
Agency Certification	• UL 508 • C-UL under CSA C22.2 no. 142 • Class I, Div. 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213) • CE/C-Tick compliant for all applicable directives/acts.			
Electrical/EMC	The controller has passed testing at the following levels: IEC1000-4-2: 4 kV contact, 8 kV air, 4 kV indirect IEC1000-4-3: 10V/m IEC1000-4-4: 2 kV, 5 kHz; communications cable: 1 kV, 5 kHz IEC1000-4-5: communications cable 1 kV galvanic gun I/O: 2 kV CM (common mode), 1 kV DM (differential mode), Power Supply: 4 kV CM (common mode), 2 kV DM (differential mode) IEC1000-4-6: 10V, communications cable 3V(3)			
Terminal Screw Torque	0.791 Nm (7 in-lb) rated			

(1) The total load watts of the 5V, 24V and user power output shall not exceed 12W.

(2) The total load watts of the 5V, 24V and user power output shall not exceed 16W.

(3) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Table A.2 Input Specifications

Description	1762-L24AWA 1762-L40AWA	1762-L24BWA and 1762-L40BWA	
		Inputs 0 through 3	Inputs 4 and higher
On-State Voltage Range	79 to 132V ac	14 to 26.4V dc at 55°C (131°F) 14 to 30.0V dc at 30°C (86°F)	10 to 26.4V dc at 55°C (131°F) 10 to 30.0V dc at 30°C (86°F)
Off-State Voltage Range	0 to 20V ac	0 to 5V dc	
Operating Frequency	47 Hz to 63 Hz	0 Hz to 20 kHz	0 Hz to 1 kHz (scan time dependent)
On-State Current:	• 50 mA at 79V dc (min.) • 12 mA at 120V dc (nom.) • 6.0 mA at 132V dc (max.)	• 2.5 mA at 14V dc (min.) • 8.8 mA at 24V dc (nom.) • 12.0 mA at 30V dc (max.)	• 2.0 mA at 10V dc (min.) • 8.5 mA at 24V dc (nom.) • 12.0 mA at 30V dc (max.)
Off-State Leakage Current	2.5 mA max.	1.5 mA min.	
Nominal Impedance	12K ohms at 50 Hz 10K ohms at 60 Hz	2.5K ohms	2.6K ohms
Inrush Current (max.) at 120V ac	250 mA	Not Applicable	

Table A.3 Output Specifications - Maximum Continuous Current

Specification	1762-L24AWA, 1762-L24BWA	1762-L40AWA, 1762-L40BWA
Current per Common	8A	8A
Current per Controller: at 150V max at 240V max	 23A(1) 20A(1)	 30A(2) 20A

(1) 15A above 40°C

(2) 24A above 40°C

Table A.4 AC Input Filter Requirements

Nominal Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
8	2	20	10	20

Table A.5 Fast DC Input Filter Requirements (Settings 0 to 3)

Maximum Counter Frequency (Hz) 50% Duty Cycle	Nominal Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
20.0 kHz	0.025	0.005	0.025	0.005	0.025
6.7 kHz	0.075	0.040	0.075	0.045	0.075
5.0 kHz	0.100	0.050	0.100	0.060	0.100
2.0 kHz	0.250	0.170	0.250	0.210	0.250
1.0 kHz	0.500	0.370	0.500	0.330	0.500
0.5 kHz	1.00	0.700	1.000	0.800	1.000
200 Hz	2.000	1.700	2.000	1.600	2.000
125 Hz	4.000	3.400	4.000	3.600	4.000
63 Hz	8.000(1)	6.700	8.000	7.300	8.000
31 Hz	16.000	14.000	16.000	14.000	16.000

(1) This is the default setting.

Table A.6 Normal DC Input Filter Requirements (Settings 4 and higher)

Maximum Counter Frequency (Hz) 50% Duty Cycle	Nominal Filter Setting (ms)	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
1.0 kHz	0.500	0.090	0.500	0.020	0.500
0.5 kHz	1.000	0.500	1.000	0.400	1.000
200 Hz	2.000	1.100	2.000	1.300	2.000
125 Hz	4.000	2.800	4.000	2.700	4.000
63 Hz	8.000(1)	5.800	8.000	5.300	8.000
31 Hz	16.000	11.000	16.000	10.000	16.000

(1) This is the default setting.

Table A.7 Relay Contact Rating Table 1762-24AWA, -24BWA, -40AWA, -40BWA

Maximum Volts	Amperes		Amperes Continuous	Voltamperes	
	Make	Break		Make	Break
240V ac	7.5A	0.75A	2.5A(1)	1800VA	180VA(2)
120V ac	15A	1.5A			
125V dc	0.22A(3)		1.0A	28VA	
24V dc	1.2A(3)		2.0A	28VA	

(1) 1.5A above 40°C

(2) The total load controlled by the 1762-24AWA, -24BWA, -40AWA and -40BWA is limited to 1440 VA (break).

(3) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 14V, the make/break ratings for relay contacts cannot exceed 2A.

Table A.8 Working Voltage (1762-L24AWA, 1762-L40AWA)

Specification	1762-L24AWA, 1762-L40AWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1517V ac for 1 second or 2145V dc for 1 second
	132V ac Working Voltage (IEC Class 2 reinforced insulation)

Table A.8 Working Voltage (1762-L24AWA, 1762-L40AWA)

Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1second
	265V ac Working Voltage (basic insulation) 150V ac Working Voltage (IEC Class 2 reinforced insulation)

Table A.9 Working Voltage (1762-L24BWA, 1762-L40BWA)

Specification	1762-L24BWA, 1762-L40BWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Power Supply User 24V Output to Backplane Isolation	Verified by one of the following dielectric tests: 600V ac for 1 second or 848V dc for 1 second
	50V Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation).
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Table A.10 Expansion I/O Current Estimates

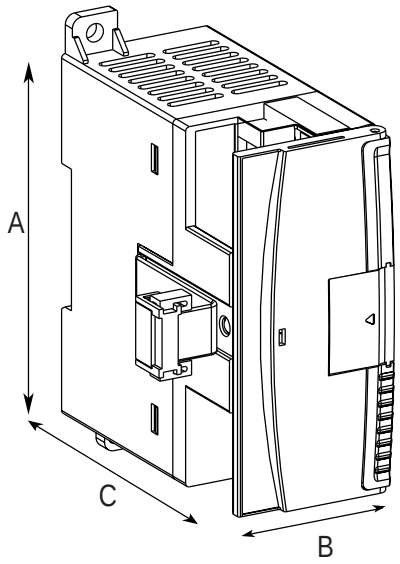
Expansion I/O Catalog Number	Estimated Current Requirement
1762-IA8	50 mA at 5V
1762-IQ8	50 mA at 5V
1762-OW8	80 mA at 5V, 90 mA at 24V
1762-IF2OF2	40 mA at 5V, 105 mA at 24V

Controller Dimensions

See Controller Mounting Dimensions on page 2-14.

Expansion I/O Dimensions

Panel Mounting



Dimension	Expansion I/O Module
A	90 mm (3.5 in.)
B	40 mm (1.57 in.)
C	87 mm (3.43 in.)

Replacement Parts

MicroLogix 1200 Replacement Kits

Controllers Replacement Doors

Catalog Number 1762-RPLDR1

The controller door kit consists of:

- Two memory module doors
- Two RS-232 communication port doors
- Two expansion bus doors

Controller Replacement Door Labels

Catalog Number 1762-RPLTLBL1

The controller terminal door label kit consists of:

- Four labels each for all available controllers

Controller Replacement DIN Latches

Catalog Number 1762-RPLDIN1

The controller DIN latch kit consists of:

- Five DIN latches for controllers

Controller 40-Point Replacement Terminal Blocks

Catalog Number 1762-RPLRTB40

The 40-point controller removable terminal blocks kit consists of:

- one 25-point double row terminal block
- one 29-point double row terminal block

(Both terminal blocks for a 40-point controller.)

Controller 24-Point Terminal Doors

Catalog Number 1762-RPLTDR24

The 24-point controller terminal door kit consists of:

- Four terminal doors
- Four sub-terminal covers.

(Enough doors for two 24-point controllers.)

Controller 40-Point Terminal Doors

Catalog Number 1762-RPLTDR40

The 40-point controller terminal door kit consists of:

- Four terminal doors
- Four sub-terminal covers

(Enough doors for two 40-point controllers.)

1762 Expansion I/O

Expansion I/O Replacement Doors

Catalog Number 1762-RPLDR2

The expansion I/O door kit consists of:

- Two expansion I/O terminal doors
- Two expansion I/O (bus doors)

Expansion I/O Replacement DIN Latches

Catalog Number 1762-RPLDIN2

The expansion I/O DIN latch kit consists of:

- Five DIN latches for expansion I/O

Expansion I/O Replacement Door Labels

Catalog Number 1762-RPLDTLBL2

The expansion I/O terminal door label kit consists of:

- Four labels each for all available modules

Troubleshooting Your System

This chapter describes how to troubleshoot your controller. Topics include:

- understanding the controller LED status
- controller error recovery model
- analog expansion I/O diagnostics and troubleshooting
- calling Rockwell Automation for assistance

Understanding the Controller LED Status

The controller status LEDs provide a mechanism to determine the current status of the controller if a programming device is not present or available.

Figure C.1 Controller LED Location

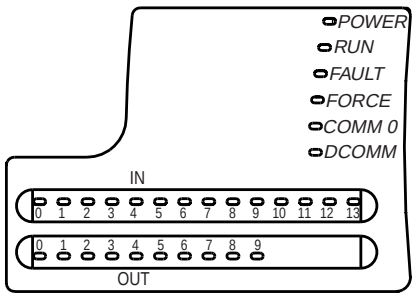


Table C.1 Controller LED Indicators

LED	Color	Indicates
POWER	off	No input power, or power error condition
	green	Power on
RUN	off	Not executing the user program
	green	Executing the user program in run mode
	green flashing	Memory module transfer occurring
FAULT	off	No fault detected
	red flashing	Application fault detected
	red	Controller hardware faulted
FORCE	off	No forces installed
	amber	Forces installed
COMM 0	off	Not transmitting via RS-232 port
	green	Transmitting via RS-232 port
DCOMM	off	Configured communications
	green	Default communications
INPUTS	off	Input is not energized
	amber	Input is energized (logic status)
OUTPUTS	off	Output is not energized
	amber	Output is engerized (logic status)

Normal Operation

The POWER and RUN LEDs are on. If a force condition is active, the FORCE LED turns on and remains on until all forces are removed.

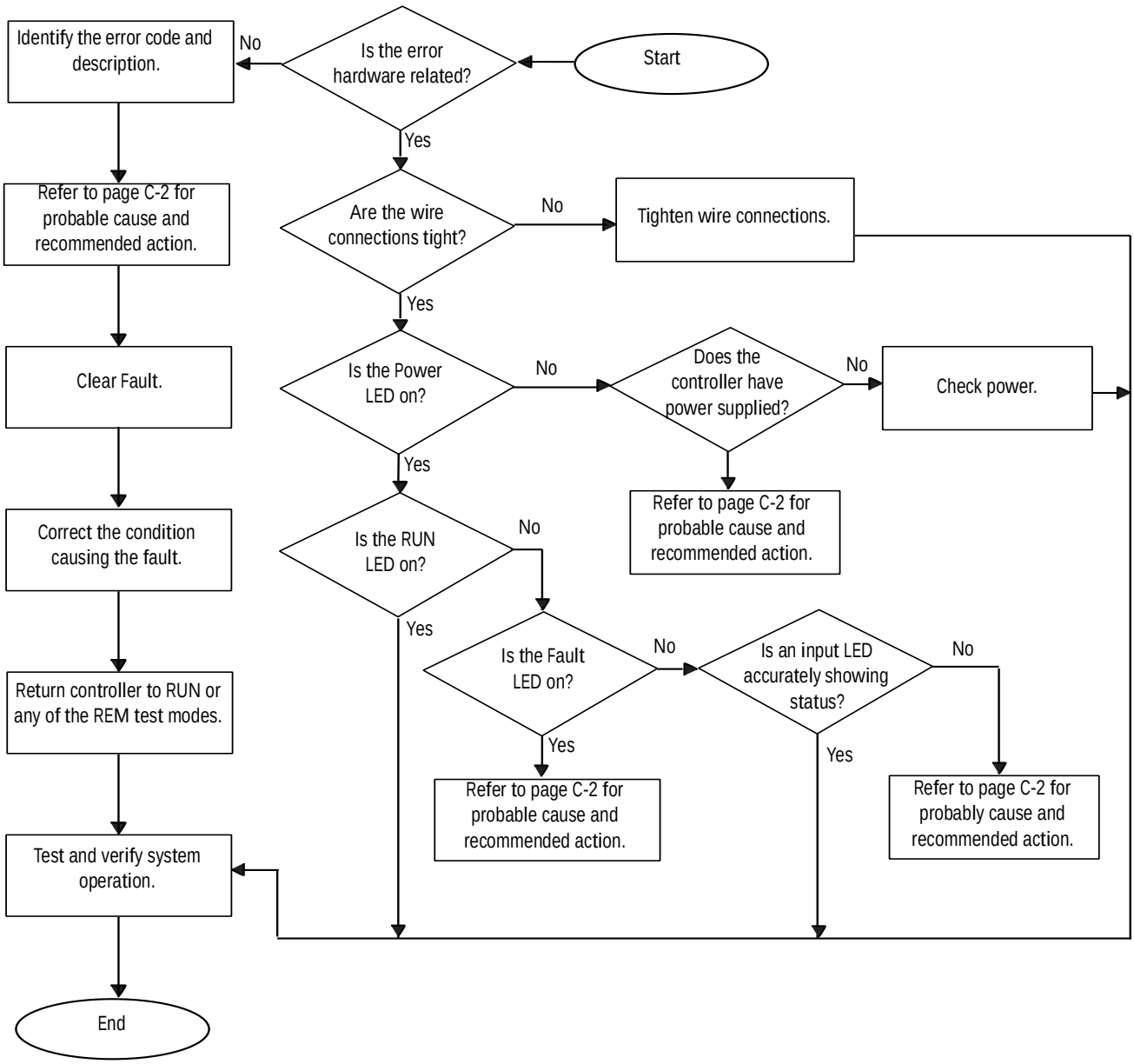
Error Conditions

If an error exists within the controller, the controller LEDs operate as described in the following table.

If the LEDS indicate:	The Following Error Exists	Probable Cause	Recommended Action
All LEDs off	No input power or power supply error	No line Power	Verify proper line voltage and connections to the controller.
		Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT LEDs on solid	Hardware faulted	Processor Hardware Error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
		Loose Wiring	Verify connections to the controller.
Power LED on and FAULT LED flashing	Application fault	Hardware/Software Major Fault Detected	For error codes and Status File information, see *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001A-US-P.
RUN FORCE FAULT LEDs all flashing	Operating system fault	Missing or Corrupt Operating System	Refer to Missing/Corrupt OS LED Pattern on page D-2.

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



Analog Expansion I/O Diagnostics and Troubleshooting

Module Operation and Channel Operation

The module performs operations at two levels:

- module level
- channel level

Module-level operations include functions such as power-up, configuration, and communication with the controller.

Internal diagnostics are performed at both levels of operation. Both module hardware and channel configuration error conditions are reported to the controller. Channel over-range or under-range conditions are reported in the module's input data table. Module hardware errors are reported in the controller's I/O status file. Refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P for more information.

When a fault condition is detected, the analog outputs are reset to zero.

Power-up Diagnostics

At module power-up, a series of internal diagnostic tests are performed.

Table C.2 Module Status LED State Table

If module status LED is:	Indicated condition:	Corrective action:
On	Proper Operation	No action required.
Off	Module Fault	Cycle power. If condition persists, replace the module. Call your local distributor or Allen-Bradley for assistance.

Critical and Non-Critical Errors

Non-critical module errors are recoverable. Channel errors (over-range or under-range errors) are non-critical. Non-critical error conditions are indicated in the module input data table. Non-critical configuration errors are indicated by the extended error code. See Table C.5 on page C-7.

Critical module errors are conditions that prevent normal or recoverable operation of the system. When these types of errors occur, the system leaves the run mode of operation. Critical module errors are indicated in Table C.5 on page C-7.

Module Error Definition Table

Analog module errors are expressed in two fields as four-digit Hex format with the most significant digit as “don’t care” and irrelevant. The two fields are “Module Error” and “Extended Error Information”. The structure of the module error data is shown below.

Table C.3 Module Error Table

“Don’t Care” Bits				Module Error			Extended Error Information								
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hex Digit 4				**Hex Digit 3**			**Hex Digit 2**					**Hex Digit 1**			

Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. These types of module errors are typically reported in the controller’s I/O status file. Refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P for more information

Table C.4 Module Error Types

Error Type	Module Error Field Value Bits 11 through 09 (Binary)	Description
No Errors	000	No error is present. The extended error field holds no additional information.
Hardware Errors	001	General and specific hardware error codes are specified in the extended error information field.
Configuration Errors	010	Module-specific error codes are indicated in the extended error field. These error codes correspond to options that you can change directly. For example, the input range or input filter selection.

Extended Error Information Field

Check the extended error information field when a non-zero value is present in the module error field. See Table C.5 on page C-7.

NOTE If no errors are present in the module error field, the extended error information field is set to zero.

Hardware Errors

General or module-specific hardware errors are indicated by module error code 2. See Table C.5 on page C-7.

Configuration Errors

If you set the fields in the configuration file to invalid or unsupported values, the module ignores the invalid configuration, generates a non-critical error, and keeps operating with the previous configuration.

Table C.5 on page C-7 lists the configuration error codes defined for the module.

Error Codes

Table C.5 Extended Error Codes

Error Type	Hex Equivalent(1)	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware-Specific Error	X210	001	0 0001 0000	Reserved
Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	Invalid input data format selected (channel 0)
	X402	010	0 0000 0010	Invalid input data format selected (channel 1)
	X403	010	0 0000 0010	Invalid output data format selected (channel 0)
	X404	010	0 0000 0100	Invalid output data format selected (channel 1)

(1) X represents “Don’t Care”.

Calling Rockwell Automation for Assistance

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, revision letter, and firmware (FRN) number of the controller
- controller LED status
- controller error codes (Refer to *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001A-US-P for error code information.)

Using Control Flash to Upgrade Your Operating System

The operating system (OS) can be upgraded through the communication port on the controller. In order to download a new operating system, you must have the following:

- ControlFlash™ Upgrade Kit containing the new OS
- a Windows 95®, Windows 98® or Windows NT™ based computer to run the download software.

The ControlFlash™ Upgrade Kit includes:

- the operating system upgrade to be downloaded
- the ControlFlash programming tool, along with its support drivers and on-line help
- a readme first file explaining how to upgrade the operating system

Preparing for Upgrade

Before upgrading the controller's operating system, you must:

- install ControlFlash software on your personal computer
- prepare the controller for updating

IMPORTANT Installing a new operating system deletes the user program. After the operating system upgrade is successful, you must transfer your control program back to the controller. The communication parameters are described on Page 4-1.

Install ControlFlash Software

Double click the 1762-LSC_FRNxx.exe file to install the operating system upgrade (where xx is the firmware revision number).

Prepare the Controller for Updating

Controller Configuration

The controller must be configured for default communications (use communications toggle push button; DCOMM LED on) and be in the Program mode to allow the download of a new operating system.

Sequence of Operation

The following steps detail the key events in the upgrade process.

1. Controller mode and communications parameters are checked.
2. Download begins.
3. During the download, the Force, Battery, and Comms LEDs perform a walking bit pattern.
4. When the download is complete, the integrity of the new OS is checked. If the new OS is corrupt, the controller sends an error message to the download tool and flashes the Missing or Corrupt OS LED pattern. See“Missing/Corrupt OS LED Pattern” below.
5. Following a successful transfer, the Power, Force, and Battery LEDs flash on and remain on for five seconds. Then the controller resets.

Missing/Corrupt OS LED Pattern

When an operating system download is not successful or if the controller does not contain a valid operating system, the controller flashes the Run, Force, and Fault LEDS on and off.

Understanding the Communication Protocols

Use the information in this appendix to understand the differences in communication protocols. The following protocols are supported from the RS-232 communication channel:

- DF1 Full-Duplex
- DF1 Half-Duplex Slave
- DH485
- Modbus

Refer to Communication Connections on page 4-1 for information about required network devices and accessories.

RS-232 Communication Interface

The communications port on the MicroLogix 1200 utilizes an RS-232 interface. RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical and mechanical characteristics for serial binary communication. It provides you with a variety of system configuration possibilities. (RS-232 is a definition of electrical characteristics; it is *not* a protocol.)

One of the biggest benefits of an RS-232 interface is that it lets you integrate telephone and radio modems into your control system (using the appropriate DF1 protocol only, not DH485 protocol).

DF1 Full-Duplex Protocol

DF1 Full-Duplex protocol provides a point-to-point connection between two devices. DF1 Full-Duplex protocol combines data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1) and 2-way simultaneous transmission with embedded responses (subcategory F1).

The MicroLogix 1200 controllers support the DF1 Full-Duplex protocol via RS-232 connection to external devices, such as computers, or other controllers that support DF1 Full-Duplex.

DF1 is an open protocol. Refer to *DF1 Protocol and Command Set Reference Manual*, publication 1770-6.5.16, for more information.

DF1 Full-Duplex Operation

DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) is useful where RS-232 point-to-point communication is required. DF1 protocol controls message flow, detects and signals errors, and retries if errors are detected.

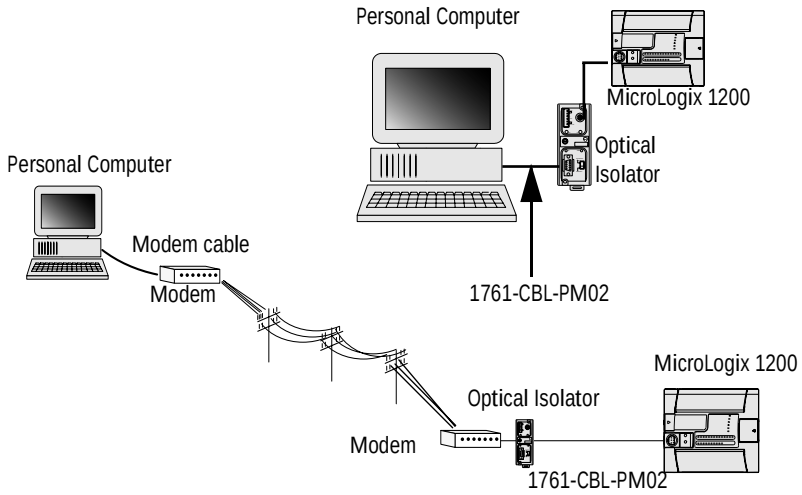
When the system driver is DF1 Full-Duplex, the following parameters can be changed:

Table E.1 DF1 Full-Duplex Configuration Parameters

Parameter	Options	Default
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even	none
Source ID (Node Address)	0 to 254 decimal	1
Control Line	no handshaking, Full-Duplex modem handshaking	no handshaking
Error Detection	CRC, BCC	CRC
Embedded Responses	auto-detect, enabled	auto detect
Duplicate Packet (Message) Detect	enabled, disabled	enabled
ACK Timeout	1 to 65535 counts (20 ms increments)	50 counts
NAK retries	0 to 255	3 retries
ENQ retries	0 to 255	3 retries
Stop Bits	not a setting, always 1	1

Example DF1 Full-Duplex Connections

For information about required network connecting equipment, see chapter 3, Connecting the System.



We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator.

DF1 Half-Duplex Protocol

DF1 Half-Duplex protocol is a multi-drop single master/multiple slave network. DF1 Half-Duplex protocol supports data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1). In contrast to DF1 Full-Duplex, communication takes place in one direction at a time. You can use the RS-232 port on the MicroLogix 1200 as both a Half-Duplex programming port and a Half-Duplex peer-to-peer messaging port.

DF1 Half-Duplex Operation

The master device initiates all communication by "polling" each slave device. The slave device may only transmit message packets when it is polled by the master. It is the master's responsibility to poll each slave on a regular and sequential basis to allow slave devices an opportunity to communicate. During a polling sequence, the master polls a slave either repeatedly until the slave indicates that it has no more message packets to transmit or just one time per polling sequence, depending on how the master is configured.

An additional feature of the DF1 Half-Duplex protocol is that it is possible for a slave device to enable a MSG instruction in its ladder program to send or request data to/from another slave. When the initiating slave is polled, the MSG instruction is sent to the master. The master recognizes that the message is not intended for it, but for another slave, so the master immediately forwards the message to the intended slave. The master does this automatically, you do not need to program the master to move data between slave nodes. This slave-to-slave transfer can also be used by programming software to allow slave-to-slave upload and download programs to processors (including the master) on the DF1 Half-Duplex link.

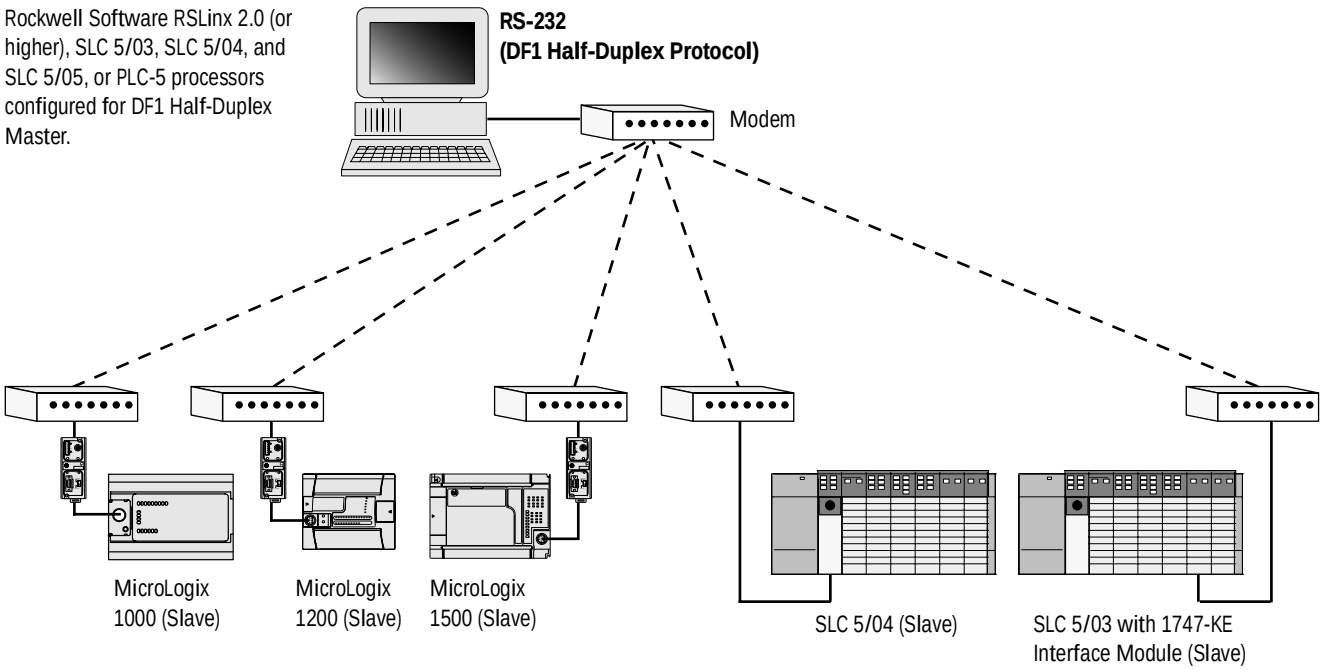
The MicroLogix 1200 can only act as a slave device. A device that can act as a master is required to "run" the network. Several Allen-Bradley products support DF1 Half-Duplex master protocol. They include the SLC 5/03™ and higher processors, enhanced PLC-5® processors and Rockwell Software RSLinx (version 2.x and higher).

DF1 Half-Duplex supports up to 255 devices (address 0 to 254) with address 255 reserved for master broadcasts. The MicroLogix 1200 supports broadcast reception. The MicroLogix 1200 also supports Half-Duplex modems using RTS/CTS hardware handshaking.

When the system driver is DF1 Half-Duplex Slave, available parameters include:

Table E.2 DF1 Half-Duplex Configuration Parameters

Parameter	Options
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K
Parity	none, even
Source ID (Node Address)	0 to 254 decimal
Control Line	no handshaking, handshaking
Error Detection	CRC, BCC
EOT Suppression	enabled, disabled When EOT Suppression is enabled, the slave does not respond when polled if no message is queued. This saves modem transmission power and time when there is no message to transmit.
Duplicate Packet (Message) Detect	enabled, disabled Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions if the sender's Message Retries are not set to 0.
Poll Timeout (x20 ms)	0 to 65535 (can be set in 20 ms increments) Poll Timeout only applies when a slave device initiates a MSG instruction. It is the amount of time that the slave device waits for a poll from the master device. If the slave device does not receive a poll within the Poll Timeout, a MSG instruction error is generated, and the ladder program needs to requeue the MSG instruction. If you are using a MSG instruction, it is recommended that a Poll Timeout value of zero not be used. Poll Timeout is disabled when set to zero.
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.
Message Retries	0 to 255 Specifies the number of times a slave device attempts to resend a message packet when it does not receive an ACK from the master device. For use in noisy environments where message packets may become corrupted in transmission.
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) • When the Control Line is set to *no handshaking*, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs delay time to change from transmit to receive mode. • When the Control Line is set to *DF1 Half-Duplex Modem*, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.



NOTE It is recommended that isolation (1761-NET-AIC) be used between channel 0 of the MicroLogix controller and the modem.

Considerations When Communicating as a DF1 Slave on a Multi-drop Link

When communication is between either your programming software and a MicroLogix Programmable Controller or between two MicroLogix Programmable Controllers via a slave-to-slave connection on a larger multi-drop link, the devices depend on a DF1 Half-Duplex Master to give each of them permission to transmit in a timely manner. As the number of slave devices increase on the link (up to 254), the time between when your programming software or the MicroLogix Controller is polled also increases. This increase in time may also be large if you are using low baud rates.

As these time periods grow, the following values may need to be changed to avoid loss of communication:

- programming software: increase poll timeout and reply timeout values
- MicroLogix Programmable Controllers: increase poll timeout and reply timeout values

IMPORTANT If a program download is started when using DF1 Half Duplex but then is interrupted, due to electromagnetic interference or other events, discontinue communications to the controller for the ownership timeout period and then restart the program download. The ownership timeout period is 60 seconds. After the timeout, you can re-establish communications with the processor and try the program download again. The only other way to remove program ownership is to cycle power on the processor.

Using Modems with MicroLogix 1200 Programmable Controllers

The types of modems you can use with MicroLogix 1200 controllers include dial-up phone modems, leased-line modems, radio modems and line drivers.

For point-to-point Full-Duplex modem connections that do not require any modem handshaking signals to operate, use DF1 Full-Duplex protocol with no handshaking. For point-to-point Full-Duplex modem connections that require RTS/CTS handshaking, use DF1 Full-Duplex protocol with handshaking.

For multi-drop modem connections, or for point-to-point modem connections that require RTS/CTS handshaking, use DF1 Half-Duplex slave protocol. In this case, one (and only one) of the other devices must be configured for DF1 Half-Duplex master protocol.

IMPORTANT Never attempt to use DH485 protocol through modems under any circumstance.

NOTE All MicroLogix 1200 controllers support RTS/CTS modem handshaking when configured for DF1 Full-Duplex protocol with the control line parameter set to Full-Duplex Modem Handshaking or DF1 Half-Duplex slave protocol with the control line parameter set to “Half-Duplex Modem”. No other modem handshaking lines (i.e. Data Set Ready, Carrier Detect and Data Terminal Ready) are supported by any MicroLogix 1200 controllers.

Dial-Up Phone Modems

Some dial-up phone line modems support point-to-point Full-Duplex communications. A MicroLogix 1200 controller, on the receiving end of the dial-up connection, can be configured for DF1 Full-Duplex protocol with or without handshaking. The modem connected to the MicroLogix controller should support auto-answer. The MicroLogix 1200 supports ASCII out communications. Therefore, it can cause a modem to initiate or disconnect a phone call.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be in a point-to-point topology supporting Full-Duplex communications between two modems or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either Half-Duplex or Full-Duplex communications, or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Line drivers are available in Full-Duplex and Half-Duplex models. Allen-Bradley's AIC+ Advanced Interface Converter is a Half-Duplex line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet (8000 feet when bridged).

DH485 Communication Protocol

The information in this section describes the DH485 network functions, network architecture, and performance characteristics. It will also help you plan and operate a MicroLogix on a DH485 network.

DH485 Network Description

The DH485 protocol defines the communication between multiple devices that coexist on a single pair of wires. DH485 protocol uses RS-485 Half-Duplex as its physical interface. (RS-485 is a definition of electrical characteristics; it is *not* a protocol.) RS-485 uses devices that are capable of co-existing on a common data circuit, thus allowing data to be easily shared between devices.

The DH485 network offers:

- interconnection of 32 devices
- multi-master capability
- token passing access control
- the ability to add or remove nodes without disrupting the network
- maximum network segment of 1219 m (4000 ft)

The DH485 protocol supports two classes of devices: initiators and responders. All initiators on the network get a chance to initiate message transfers. To determine which initiator has the right to transmit, a token passing algorithm is used.

The following section describes the protocol used to control message transfers on the DH485 network.

DH485 Token Rotation

A node holding the token can send a message onto the network. Each node is allowed a fixed number of transmissions (based on the Token Hold Factor) each time it receives the token. After a node sends a message, it passes the token to the next device.

The allowable range of node addresses is 0 to 31. There must be at least one initiator on the network such as a MicroLogix controller, or an SLC 5/02™ or higher processor.

DH485 Configuration Parameters

When MicroLogix communications are configured for DH485, the following parameters can be changed:

Table E.3 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

Refer to Software Considerations on page E-12 for tips on setting the parameters listed above.

Devices that use the DH485 Network

In addition to the MicroLogix 1200 controllers, the devices shown in the following table also support the DH485 network.

Table E.4 Allen-Bradley Devices that Support DH485 Communication

Catalog Number	Description	Installation	Function	Publication
Bulletin 1761 Controllers	MicroLogix 1000	Series C or higher	These controllers support DH485 communications.	1761-6.3
Bulletin 1764	MicroLogix 1500	Series A or higher	These controllers support DH485 communications.	1764-6.1
Bulletin 1747 Processors	SLC 500 Processors	SLC Chassis	These processors support a variety of I/O requirements and functionality.	1747-6.2
1746-BAS	BASIC Module	SLC Chassis	Provides an interface for SLC 500 devices to foreign devices. Program in BASIC to interface the 3 channels (2 RS232 and 1 DH485) to printers, modems, or the DH485 network for data collection.	1746-6.1 1746-6.2 1746-6.3
1785-KA5	DH+™/DH485 Gateway	(1771) PLC Chassis	Provides communication between stations on the PLC-5® (DH+) and SLC 500 (DH485) networks. Enables communication and data transfer from PLC® to SLC 500 on DH485 network. Also enables programming software programming or data acquisition across DH+ to DH485.	1785-6.5.5 1785-1.21
2760-RB	Flexible Interface Module	(1771) PLC Chassis	Provides an interface for SLC 500 (using protocol cartridge 2760-SFC3) to other A-B PLCs and devices. Three configurable channels are available to interface with Bar Code, Vision, RF, Dataliner™, and PLC systems.	1747-KE 2760-ND001
1784-KTX, -KTXD	PC DH485 IM	IBM XT/AT Computer Bus	Provides DH485 using RSLinx.	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH485 using RSLinx.	1784-6.5.19

Table E.4 Allen-Bradley Devices that Support DH485 Communication

Catalog Number	Description	Installation	Function	Publication
1747-PT1	Hand-Held Terminal	NA	Provides hand-held programming, monitoring, configuring, and troubleshooting capabilities for SLC 500 processors.	1747-NP002
1747-DTAM, 2707-L8P1, -L8P2, -L40P1, -L40P2, -V40P1, -V40P2, -V40P2N, -M232P3, and -M485P3	DTAM, DTAM Plus, and DTAM Micro Operator Interfaces	Panel Mount	Provides electronic operator interface for SLC 500 processors.	1747-ND013 2707-800, 2707-803
2711-K5A2, -B5A2, -K5A5, -B5A5, -K5A1, -B5A1, -K9A2, -T9A2, -K9A5, -T9A5, -K9A1, and -T9A1	PanelView 550 and PanelView 900 Operator Terminals	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2711-802, 2711-816

NA = Not Applicable

Important DH485 Network Planning Considerations

Carefully plan your network configuration before installing any hardware. Listed below are some of the factors that can affect system performance:

- amount of electrical noise, temperature, and humidity in the network environment
- number of devices on the network
- connection and grounding quality in installation
- amount of communication traffic on the network
- type of process being controlled
- network configuration

The major hardware and software issues you need to resolve before installing a network are discussed in the following sections.

Hardware Considerations

You need to decide the length of the communication cable, where you route it, and how to protect it from the environment where it will be installed.

When the communication cable is installed, you need to know how many devices are to be connected during installation and how many devices will be added in the future. The following sections help you understand and plan the network.

Number of Devices and Length of Communication Cable

The maximum length of the communication cable is 1219m (4000 ft). This is the total cable distance from the first node to the last node in a segment. However, two segments can be used to extend the DH485 network to 2438m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual*, publication 1761-6.4.

Planning Cable Routes

Follow these guidelines to help protect the communication cable from electrical interference:

- Keep the communication cable at least 1.52m (5 ft) from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.
- If you do not run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.15m (6 in.) from ac power lines of less than 20A, 0.30m (1 ft) from lines greater than 20A, but only up to 100K VA, and 0.60m (2 ft) from lines of 100K VA or more.
- If you run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.08m (3 in.) from ac power lines of less than 20A, 0.15m (6 in.) from lines greater than 20A, but only up to 100K VA, and 0.30m (1 ft) from lines of 100K VA or more.

Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

– Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminum conduit in non-critical areas.

– Use plastic connectors to couple between aluminum and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.

– Ground the entire length of conduit by attaching it to the building earth ground.

– Do not let the conduit touch the plug on the cable.

– Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.

– Install the conduit so that it meets all applicable codes and environmental specifications.

For more information on planning cable routes, see *Industrial Automation Wiring and Grounding Guidelines*, publication Number 1770-4.1.

Software Considerations

Software considerations include the configuration of the network and the parameters that can be set to the specific requirements of the network. The following are major configuration factors that have a significant effect on network performance:

- number of nodes on the network
- addresses of those nodes
- baud rate

The following sections explain network considerations and describe ways to select parameters for optimum network performance (speed). See your programming software's user manual for more information.

Number of Nodes

The number of nodes on the network directly affects the data transfer time between nodes. Unnecessary nodes (such as a second programming terminal that is not being used) slow the data transfer rate. The maximum number of nodes on the network is 32.

Setting Node Addresses

The best network performance occurs when node addresses are assigned in sequential order. Initiators, such as personal computers, should be assigned the lowest numbered addresses to minimize the time required to initialize the network. The valid range for the MicroLogix 1200 controllers is 1-31 (controllers cannot be node 0). The default setting is 1. The node address is stored in the controller Communications Status file (CS0:5/0 to CS0:5/7).

Setting Controller Baud Rate

The best network performance occurs at the highest baud rate, which is 19200. This is the default baud rate for a MicroLogix 1200 device on the DH485 network. All devices must be at the same baud rate. This rate is stored in the controller Communications Status file (CS0:5/8 to CS0:5/15).

Setting Maximum Node Address

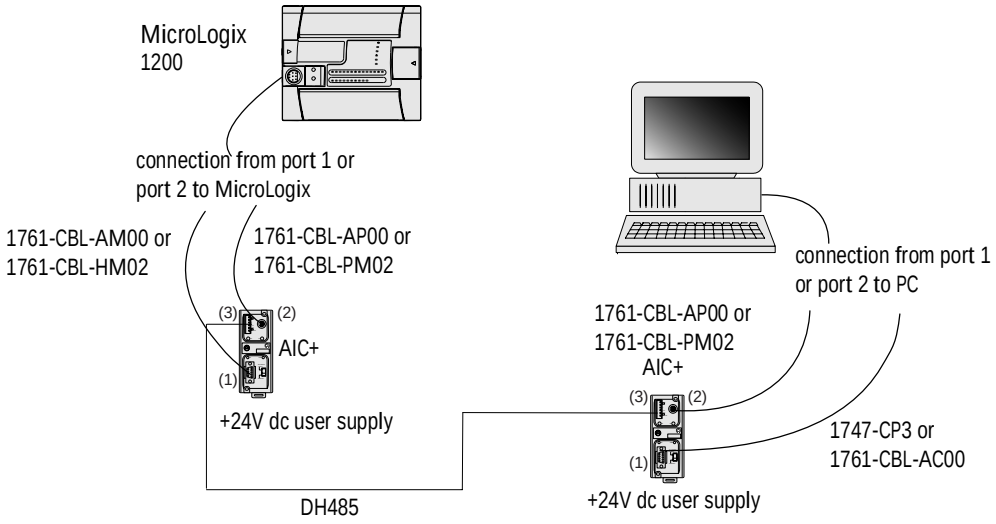
Once you have an established network set up and are confident that you will not be adding more devices, you may enhance performance by adjusting the maximum node address of your controllers. It should be set to the highest node address being used.

IMPORTANT All devices should be set to the same maximum node address.

Example DH485 Connections

The following network diagrams provide examples of how to connect MicroLogix 1200 controllers to the DH485 network using the Advanced Interface Converter (AIC+, catalog number 1761-NET-AIC). For more information on the AIC+, see the *Advanced Interface Converter and DeviceNet Interface Installation Instructions*, Publication 1761-5.11.

DH485 Network with a MicroLogix 1200 Controller



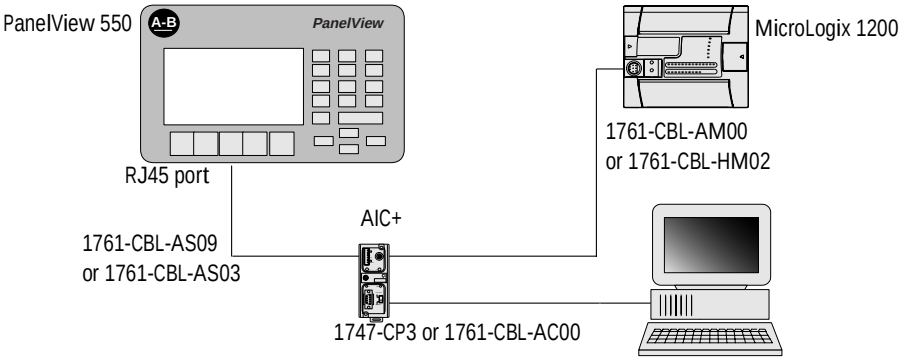
(1) DB-9 RS-232 port

(2) mini-DIN 8 RS-232 port

(3) RS-485 port

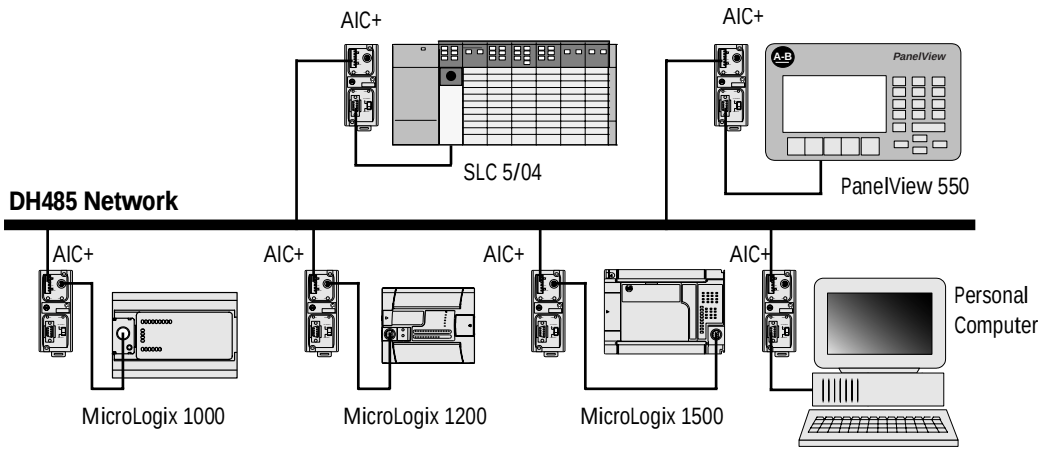
NOTE Series C or higher cables are required.

Typical 3-Node Network



NOTE This 3-node network is not expandable.

Networked Operator Interface Device and MicroLogix Controllers



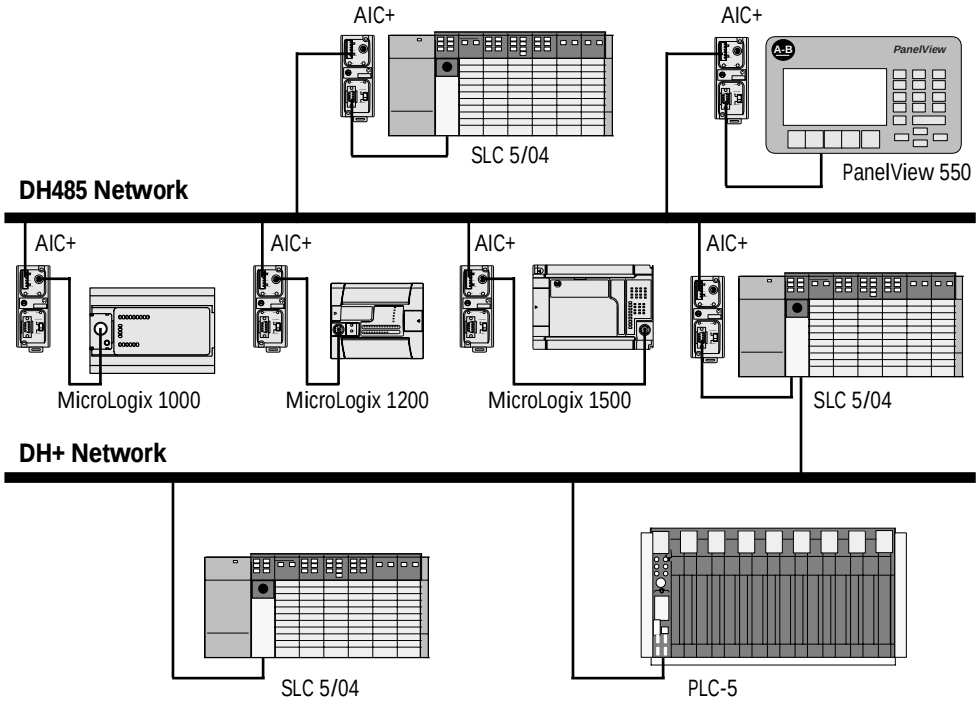
MicroLogix Remote Packet Support

MicroLogix 1200 controllers can respond and initiate with communications (or commands) that do not originate on the local DH485 network. This is useful in installations where communication is needed between the DH485 and DH+ networks.

The example below shows how to send messages from a PLC device or a PC on the DH+ network to a MicroLogix controller on the DH485 network. This method uses an SLC 5/04 processor bridge connection.

When using this method (as shown in the following illustration):

- PLC-5 devices can send read and write commands to MicroLogix 1200 controllers.
- MicroLogix 1200 controllers can respond to MSG instructions received.
- The MicroLogix 1200 controllers can initiate MSG instructions to devices on the DH+ network.
- PC can send read and write commands to MicroLogix 1200 controllers.
- PC can do remote programming of MicroLogix 1200 controllers.


AIC+
AIC+
SLC 5/04
PanelView 550
DH485 Network
AIC+
AIC+
AIC+
AIC+
MicroLogix 1000
MicroLogix 1200
MicroLogix 1500
SLC 5/04
DH+ Network
SLC 5/04
PLC-5

Modbus Communication Protocol

Modbus is a Half-Duplex, master-slave communications protocol. The Modbus network master reads and writes coils and registers.

Modbus protocol allows a single master to communicate with a maximum of 255 slave devices.

For more information on the MicroLogix 1200 configuration parameters for Modbus Slave RTU (*Remote Terminal Unit* transmission mode) protocol, refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001A-US-P. For more information about the Modbus Slave protocol, see the Modbus Protocol Specifications (available from http://www.modicon.com/techpubs/).

Table E.5 Modbus to MicroLogix Memory Map

Modbus Addressing	Description	Valid MicroLogix Addressing		
		File Type	Data File Number	Address
0001 to 4096	Read/Write Modbus Coil Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
10001 to 14096	Read-Only Modbus Contact Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
30001 to 30256	Read-Only Modbus Input Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
30501 to 30532	Modbus Communication Parameters	Communication Status Files	2	words 0 to 31
31501 to 31566	Read-Only System Status File space	Status (S)	2	words 32 to 65
40001 to 40256	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
41501 to 41566	Read/Write System Status File space	Status (S)	2	words 0 to 65

System Loading and Heat Dissipation

System Loading Limitations

When you connect MicroLogix accessories and expansion I/O, an electrical load is placed on the controller power supply. This section shows how to calculate the load and validate that the system will not exceed the capacity of the controller power supply.

The following example is provided to illustrate system loading validation. The system validation procedure accounts for the amount of 5V dc and 24V dc current consumed by controller, expansion I/O, and user-supplied equipment. Refer to System Loading Worksheet on page F-3 to validate your specific configuration.

Current consumed by the processor, memory modules, and the real-time clock modules has already been factored into the calculations. A system is valid if the current and power requirements are satisfied.

System Loading Example Calculations (24-Point Controller)

Current Loading

Table F.1 Calculating the Current for MicroLogix Accessories

Catalog Number	Device Current Requirements		Calculated Current	
	at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120	0	120
Subtotal 1:			**0**	**120**

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.2 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	Device Current Requirements (max)		Calculated Current	
		at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1762-IA8	2	50	0	100	0
1762-OW8	2	80	90	160	180
1762-IQ8		50	0		
1762-IF2OF2		40	105		
Total Modules (4 maximum):	**4**	**Subtotal 2:**		**260**	**180**

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in the tables below are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values* < *Maximum Allowable Current Values*
- *Calculated System Loading* < *Maximum Allowable System Loading*

Table F.3 Validating Systems Using 1762-24AWA

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 + Subtotal 2 from page F-1.):	
400 mA at 5V dc	350 mA at 24V dc	0 mA + 260 mA = 260 mA at 5V dc	120 mA + 180 mA = 300 mA at 24V dc
System Loading:		System Loading:	
10.4 Watts		= (260 mA x 5V) + (300 mA x 24V) = (1300 mW) + (7200 mW) = 8500 mW = 8.50 Watts	

Table F.4 Validating Systems using 1762-24BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc User Supply:		Sum of all sensor currents and/or 1761-NET-AIC connected to the +24V dc user supply (AIC+ selector switch in the down position[1]):	
350 mA at 24V dc		150 mA at 24V dc (example sensor value)	
Current for MicroLogix Accessories and Expansion I/O:		Current Values (Subtotal 1 + Subtotal 2 from page F-1.):	
400 mA at 5V dc	350 mA at 24V dc	0 mA + 260 mA = 260 mA at 5V dc	120 mA + 180 mA = 300 mA at 24V dc
System Loading:		System Loading:	
12 Watts		= (150 mA x 24V) + (260 mA x 5V) + (300 mA x 24V) = (3600 mW) + (1800 mW) + (7200 mW) = 12,100 mW = 12.10 Watts	

(1) No current is consumed from the controller when the AIC+ is powered by an external source.

System Loading Worksheet

The tables below are provided for system loading validation. See "System Loading Example Calculations (24-Point Controller)" on page F-1.

Current Loading

Table F.5 Calculating the Current for MicroLogix Accessories

Catalog Number	**Device Current Requirements**		**Calculated Current**	
	at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1761-NET-AIC[1] when powered by the base unit communications port, selector switch in the up position	0	120		
Subtotal 1:				

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.6 Calculating the Current for Expansion I/O

Catalog Number[1]	**n**	**A**	**B**	**n x A**	**n x B**
	Number of Modules	**Device Current Requirements**		**Calculated Current**	
		at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1762-IA8		50	0		
1762-OW8		80	90		
1762-IQ8		50	0		
1762-IF2OF2		40	105		
Total Modules (4 maximum):		**Subtotal 2:**			

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in the tables below are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values < Maximum Allowable Current Values*
- *Calculated System Loading < Maximum Allowable System Loading*

Table F.7 Validating Systems using 1762-24AWA

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 + Subtotal 2 from page F-1.):	
400 mA at 5V dc	350 mA at 24V dc		
System Loading:		System Loading:	
10.4 Watts			

Table F.8 Validating Systems using 1762-24BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc User Supply:		Sum of all sensor currents and/or 1761-NET-AIC connected to the +24V dc user supply (AIC+ selector switch in the down position(1)):	
350 mA at 24V dc			**mA at 24V dc**
Current for MicroLogix Accessories and Expansion I/O:		Current Values (Subtotal 1 + Subtotal 2 from page F-1.):	
400 mA at 5V dc	350 mA at 24V dc	**mA at 5 V dc**	**mA at 24V dc**
System Loading:		System Loading:	
12 Watts		= (_____ mA x 24V) + (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW + _____ mW = _____ mW = _____ W	

(1) No current is consumed from the controller when the AIC+ is powered by an external source.

System Loading Example Calculations (40-Point Controller)

Current Loading

Table F.9 Calculating the Current for MicroLogix Accessories

Catalog Number	Device Current Requirements		Calculated Current	
	at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120	0	120
Subtotal 1:			**0**	**120**

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.10 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	Device Current Requirements (max)		Calculated Current	
		at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1762-IA8	2	50	0	100	0
1762-OW8	3	80	90	240	270
1762-IQ8	1	50	0	50	0
1762-IF2OF2		40	105		
Total Modules (6 maximum):	**6**	**Subtotal 2:**		**390**	**270**

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in the tables below are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values < Maximum Allowable Current Values*
- *Calculated System Loading < Maximum Allowable System Loading*

Table F.11 Validating Systems using 1762-40AWA

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 + Subtotal 2 from page F-1.):	
600 mA at 5V dc	500 mA at 24V dc	0 mA + 390 mA = 390 mA at 5V dc	120 mA + 270 mA = 390 mA at 24V dc
System Loading:		System Loading:	
15 Watts		= (390 mA x 5V) + (390 mA x 24V) = (1950 mW) + (9360 mW) = 11,310 mW = 11.31 Watts	

Table F.12 Validating Systems using 1762-40BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc User Supply:		Sum of all current sensors and/or 1761-NET-AIC connected to the +24V dc user supply (AIC+ selector switch in the down position(1)):	
500 mA at 24V dc		150 mA at 24V dc (example sensor value)	
Current for MicroLogix Accessories and Expansion I/O:		Current Values (Subtotal 1 + Subtotal 2 from page F-1.):	
600 mA at 5V dc	500 mA at 24V dc	0 mA + 390 mA = 390 mA at 5V dc	120 mA + 270 mA = 390 mA at 24V dc
System Loading:		System Loading:	
16 Watts		= (150 mA x 24V) + (390 mA x 5V) + (390 mA x 24V) = (3600 mW) + (1950 mW) + (9360 mW) = 14.910 mW = 14.91 Watts	

(1) No current is consumed from the controller when the AIC+ is powered by an external source.

System Loading Worksheet

The tables below are provided for system loading validation. See “System Loading Example Calculations (24-Point Controller)” on page F-1.

Current Loading

Table F.13 Calculating the Current for MicroLogix Accessories

Catalog Number	Device Current Requirements		Calculated Current	
	at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120		
Subtotal 1:				

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.14 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	Device Current Requirements		Calculated Current	
		at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1762-IA8		50	0		
1762-OW8		80	90		
1762-IQ8		50	0		
1762-IF2OF2		40	105		
Total Modules (6 maximum):		**Subtotal 2:**			

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in the tables below are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values < Maximum Allowable Current Values*
- *Calculated System Loading < Maximum Allowable System Loading*

Table F.15 Validating Systems using 1762-40AWA

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 + Subtotal 2 from page F-1.):	
600 mA at 5V dc	500 mA at 24V dc		
System Loading:		System Loading:	
15 Watts			

Table F.16 Validating Systems using 1762-40BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc User Supply:		Sum of all sensor currents and/or 1761-NET-AIC connected to the +24V dc user supply (AIC+ selector switch in the down position(1)):	
400 mA at 24V dc		**mA at 24V dc**	
Current for MicroLogix Accessories and Expansion I/O:		Current Values (Subtotal 1 + Subtotal 2 from page F-1.):	
500 mA at 5V dc	500 mA at 24V dc	**mA at 5 V dc**	**mA at 24V dc**
System Loading:		System Loading:	
16 Watts		= (_____ mA x 24V) + (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW + _____ mW = _____ mW = _____ W	

(1) No current is consumed from the controller when the AIC+ is powered by an external source.

Calculating Heat Dissipation

Use the following table when you need to determine the heat dissipation for installation in an enclosure. Use the following table. For System Loading, take the value from the table on page F-4:

Catalog Number	**Heat Dissipation**		
	Equation or Constant	**Calculation**	**Sub-Total**
1762-24AWA	14W + (0.4 x System Loading)	14W + (0.4 x _____ W)	
1762-24BWA	16W + (0.4 x System Loading)	16W + (0.4 x _____ W)	
1762-40AWA	17.5W + (0.4 x System Loading)	17.5W + (0.4 x _____ W)	
1762-40BWA	20W + (0.4 x System Loading)	20W + (0.4 x _____ W)	
Add Sub-Totals to determine Heat Dissipation			

The following terms are used throughout this manual. Refer to the *Allen-Bradley Industrial Automation Glossary*, Publication Number AG-7.1, for a complete guide to Allen-Bradley technical terms.

address
A character string that uniquely identifies a memory location. For example, I:1/0 is the memory address for the data located in the Input file location word1, bit 0.

AIC+ Advanced Interface Converter
A device that provides a communication link between various networked devices. (Catalog Number 1761-NET-AIC.)

application
1) A machine or process monitored and controlled by a controller.
2) The use of computer- or processor-based routines for specific purposes.

baud rate
The speed of communication between devices. All devices must communicate at the same baud rate on a network.

bit
The smallest storage location in memory that contains either a 1 (ON) or a 0 (OFF).

block diagrams
A schematic drawing.

Boolean operators
Logical operators such as AND, OR, NAND, NOR, NOT, and Exclusive-OR that can be used singularly or in combination to form logic statements or circuits. Can have an output response of T or F.

branch
A parallel logic path within a rung of a ladder program.

communication scan
A part of the controller's operating cycle. Communication with other devices, such as software running on a personal computer, takes place.

controller
A device, such as a programmable controller, used to monitor input devices and control output devices.

controller overhead
An internal portion of the operating cycle used for housekeeping and set-up purposes.

control profile
The means by which a controller determines which outputs turn on under what conditions.

counter
1) An electro-mechanical relay-type device that counts the occurrence of some event. May be pulses developed from operations such as switch closures or interruptions of light beams.
2) In controllers, a software counter eliminates the need for hardware counters. The software counter can be given a preset count value to count up or down whenever the counted event occurs.

CPU (Central Processing Unit)
The decision-making and data storage section of a programmable controller.

data table
The part of processor memory that contains I/O values and files where data is monitored, manipulated, and changed for control purposes.

DIN rail
Manufactured according to Deutsche Industrie Normenausshus (DIN) standards, a metal railing designed to ease installation and mounting of your controller.

download
Data is transferred from a programming or storage device to another device.

DTE (Data Terminal Equipment)
Equipment that is attached to a network to send or receive data, or both.

embedded I/O
Embedded I/O is the controller's on-board I/O.

EMI
Electromagnetic interference.

encode
1) A rotary device that transmits position information.
2) A device that transmits a fixed number of pulses for each revolution.

executing mode
Any run or test mode.

expansion I/O
Expansion I/O is I/O that is connected to the controller via a bus or cable. MicroLogix 1200 controllers use Bulletin 1762 expansion I/O.

false
The status of an instruction that does not provide a continuous logical path on a ladder rung.

FIFO (First-In-First-Out)
The order that data is entered into and retrieved from a file.

file
A collection of information organized into one group.

full-duplex
A bidirectional mode of communication where data may be transmitted and received simultaneously (contrast with half-duplex).

half-duplex
A communication link in which data transmission is limited to one direction at a time.

hard disk
A storage area in a personal computer that may be used to save processor files and reports for future use.

high byte
Bits 8-15 of a word.

input device
A device, such as a push button or a switch, that supplies signals through input circuits to the controller.

inrush current
The temporary surge current produced when a device or circuit is initially energized.

instruction
A mnemonic and data address defining an operation to be performed by the processor. A rung in a program consists of a set of input and output instructions. The input instructions are evaluated by the controller as being true or false. In turn, the controller sets the output instructions to true or false.

instruction set
The set of general purpose instructions available with a given controller.

I/O (Inputs and Outputs)
Consists of input and output devices that provide and/or receive data from the controller.

jump
Change in normal sequence of program execution, by executing an instruction that alters the program counter (sometimes called a branch). In ladder programs a JUMP (JMP) instruction causes execution to jump to a labeled rung.

ladder logic
A program written in a format resembling a ladder-like diagram. The program is used by a programmable controller to control devices.

least significant bit (LSB)
The digit (or bit) in a binary word (code) that carries the smallest value of weight.

LED (Light Emitting Diode)
Used as status indicator for processor functions and inputs and outputs.

LIFO (Last-In-First-Out)
The order that data is entered into and retrieved from a file.

low byte
Bits 0-7 of a word.

logic
A process of solving complex problems through the repeated use of simple functions that can be either true or false. General term for digital circuits and programmed instructions to perform required decision making and computational functions.

Master Control Relay (MCR)
A mandatory hard-wired relay that can be de-energized by any series-connected emergency stop switch. Whenever the MCR is de-energized, its contacts open to de-energize all application I/O devices.

mnemonic
A simple and easy to remember term that is used to represent a complex or lengthy set of information.

modem
Modulator/demodulator. Equipment that connects data terminal equipment to a communication line.

modes
Selected methods of operation. Example: run, test, or program.

negative logic
The use of binary logic in such a way that “0” represents the voltage level normally associated with logic 1 (for example, 0 = +5V, 1 = 0V). Positive is more conventional (for example, 1 = +5V, 0 = 0V).

network
A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

nominal input current
The current at nominal input voltage.

normally closed
Contacts on a relay or switch that are closed when the relay is de-energized or the switch is deactivated; they are open when the relay is energized or the switch is activated. In ladder programming, a symbol that allows logic continuity (flow) if the referenced input is logic “0” when evaluated.

normally open
Contacts on a relay or switch that are open when the relay is de-energized or the switch is deactivated. (They are closed when the relay is energized or the switch is activated.) In ladder programming, a symbol that allows logic continuity (flow) if the referenced input is logic “1” when evaluated.

off-delay time
The OFF delay time is a measure of the time required for the controller logic to recognize that a signal has been removed from the input terminal of the controller. The time is determined by circuit component delays and by any filter adjustment applied.

offline
Describes devices not under direct communication.

offset
The steady-state deviation of a controlled variable from a fixed point.

off-state leakage current
When an ideal mechanical switch is opened (off-state) no current flows through the switch. Practical semiconductor switches, and the transient suppression components which are sometimes used to protect switches, allow a small current to flow when the switch is in the off state. This current is referred to as the off-state leakage current. To ensure reliable operation, the off-state leakage current rating of a switch should be less than the minimum operating current rating of the load that is connected to the switch.

on-delay time
The ON delay time is a measure of the time required for the controller logic to recognize that a signal has been presented at the input terminal of the controller.

one-shot
A programming technique that sets a bit for only one program scan.

online
Describes devices under direct communication. For example, when RSLogix 500 is monitoring the program file in a controller.

operating voltage
For inputs, the voltage range needed for the input to be in the On state. For outputs, the allowable range of user-supplied voltage.

output device
A device, such as a pilot light or a motor starter coil, that receives data from the controller.

processor
A Central Processing Unit. (See CPU.)

processor file
The set of program and data files used by the controller to control output devices. Only one processor file may be stored in the controller at a time.

program file
The area within a processor file that contains the ladder logic program.

program mode
When the controller is not executing the processor file and all outputs are de-energized.

program scan
A part of the controller's operating cycle. During the scan the ladder program is executed and the output data file is updated based on the program and the input data file.

programming device
Executable programming package used to develop ladder diagrams.

protocol
The packaging of information that is transmitted across a network.

read
To acquire data from a storage place. For example, the processor READs information from the input data file to solve the ladder program.

relay
An electrically operated device that mechanically switches electrical circuits.

relay logic
A representation of the program or other logic in a form normally used for relays.

restore
To download (transfer) a program from a personal computer to a controller.

reserved bit
A status file location that the user should not read or write to.

retentive data
Information associated with data files (timers, counters, inputs, and outputs) in a program that is preserved through power cycles.

RS-232
An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits. A single-ended serial communication interface.

run mode
This is an executing mode during which the controller scans or executes the ladder program, monitors input devices, energizes output devices, and acts on enabled I/O forces.

rung
Ladder logic is comprised of a set of rungs. A rung contains input and output instructions. During Run mode, the inputs on a rung are evaluated to be true or false. If a path of true logic exists, the outputs are made true. If all paths are false, the outputs are made false.

save
To upload (transfer) a program stored in memory from a controller to a personal computer; OR to save a program to a computer hard disk.

scan time
The time required for the controller to execute the instructions in the program. The scan time may vary depending on the instructions and each instruction's status during the scan.

sinking
A term used to describe current flow between an I/O device and controller I/O circuit — typically, a sinking device or circuit provides a path to ground, low, or negative side of power supply.

sourcing
A term used to describe current flow between an I/O device and controller I/O circuit — typically, a sourcing device or circuit provides a path to the source, high, or positive side of power supply.

status
The condition of a circuit or system, represented as logic 0 (OFF) or 1 (ON).

terminal
A point on an I/O module that external I/O devices, such as a push button or pilot light, are wired to.

throughput
The time between when an input turns on and the corresponding output turns on.

true
The status of an instruction that provides a continuous logical path on a ladder rung.

upload
Data is transferred to a programming or storage device from another device.

watchdog timer
A timer that monitors a cyclical process and is cleared at the conclusion of each cycle. If the watchdog runs past its programmed time period, it causes a fault.

workspace
The main storage available for programs and data and allocated for working storage.

write
To copy data to a storage device. For example, the processor WRITEs the information from the output data file to the output modules.

Numerics

1762-24AWA wiring diagram *3-10*
1762-24BWA sinking wiring diagram *3-11*
1762-24BWA sourcing wiring diagram *3-11*, *3-12*, *3-13*
1762-IA8 wiring diagram *3-14*
1762-IF2OF2 terminal block layout *3-16*
1762-IF2OF2 wiring *3-16*
1762-IQ8 wiring diagram *3-15*
1762-OW8 wiring diagram *3-15*

A

address *G-1*
agency certifications *2-1*
AIC+
  applying power to *4-15*
  attaching to the network *4-15*
  connecting *4-10*
    isolated modem *4-4*
  installing *4-15*
  recommended user supplied components *4-14*
  safety consideration *4-15*
  selecting cable *4-12*
AIC+ Advanced Interface Converter *G-1*
analog expansion I/O *C-4*
  diagnostics *C-4*
  module operation vs. channel operation *C-4*
  power-up diagnostics *C-4*
  troubleshooting *C-4*
application *G-1*

B

battery *6-2*
baud rate *G-1*
bit *G-1*
block diagrams *G-1*
Boolean operators *G-1*
branch *G-1*

C

cables
  planning routes for DH485 connections *E-11*
  selection guide for the AIC+ *4-12*
  selection guide for the DeviceNet network *4-17*
calling for assistance *C-7*
CE mark *2-2*
common techniques used in this manual *P-3*
communication
  DeviceNet *4-17*
communication connections *4-1*
communication options *1-3*
communication protocols
  DF1 Full-Duplex *E-1*
  DF1 Half-Duplex *E-3*
  DH485 *E-8*
  Modbus *E-17*
communication scan *G-1*
communications toggle push button
  using *4-2*
component descriptions *1-2*
  1762 expansion I/O *1-2*
  communication cables *1-3*
  memory module *1-2*
  real-time clock *1-2*
configuration errors *C-6*
connecting expansion I/O *2-20*
connecting the system
  AIC+ *4-10*, *4-15*
  DeviceNet network *4-17*
  DF1 Full-Duplex protocol *4-2*
  DF1 isolated point-to-point connection *4-3*
  DH485 network *4-7*
connecting to DF1 Half-Duplex network *4-6*
contacting Rockwell Automation for assistance *P-3*
contactors (bulletin 100), surge suppressors for *3-5*
control profile *G-2*
ControlFlash
  missing/corrupt OS LED pattern *D-2*
  sequence of operation *D-2*
  using *D-1*
controller *G-1*
  grounding *3-6*
  I/O wiring *3-14*
  installation *2-1*
  LED status *C-1*
  LED status error conditions *C-2*
  LED status normal operation *C-2*
  minimizing electrical noise *3-14*
  mounting *2-15*
  mounting dimensions *2-14*
  mounting on DIN rail *2-16*
  mounting on panel *2-17*
  preventing excessive heat *2-8*
controller overhead *G-1*
controller spacing *2-14*
counter *G-2*
CPU (Central Processing Unit) *G-2*

D

data table *G-2*
default communication configuration *4-1*
DeviceNet Communications *4-17*
DeviceNet network
  connecting *4-17*
  selecting cable *4-17*
DF1 Full-Duplex protocol
  configuration parameters *E-2*
  connecting *4-2*, *4-3*
  description *E-1*
  example system configuration *E-2*
  using a modem *4-4*, *E-6*
DF1 Half-Duplex protocol
  description *E-3*
DH485 communication protocol
  configuration parameters *E-9*
DH485 network
  configuration parameters *E-12*
  connecting *4-7*
  description *E-8*
  devices that use the network *E-9*
  example system configuration *E-13*
  installation *4-7*
  planning considerations *E-10*
  protocol *E-8*
  token rotation *E-8*
DIN rail *G-2*
disconnecting main power *2-5*
download *G-2*
DTE (Data Terminal Equipment) *G-2*

E

Electronics Industries Association (EIA) *E-1*
EMC Directive *2-2*
EMI *G-2*
encoder *G-2*
error recovery model *C-3*
errors
  configuration *C-6*
  critical *C-4*
  extended error information field *C-6*
  hardware *C-6*
  module error field *C-5*
  non-critical *C-4*
European Union Directive compliance *2-2*
  EMC Directive *2-2*
  low voltage directive *2-2*
executing mode *G-2*
expansion I/O mounting *2-18*, *2-19*
  mounting on DIN rail *2-18*
expansion I/O wiring *3-14*
  1762-IA8 wiring diagram *3-14*
  1762-IF2OF2 terminal block layout *3-16*
  1762-IF2OF2 wiring *3-16*
  1762-IQ8 wiring diagram *3-15*
  1762-OW8 wiring diagram *3-15*
extended error information field *C-6*

F

false *G-2*
FIFO (First-In-First-Out) *G-3*
file *G-3*
Full-Duplex *4-3*
full-duplex *G-3*

G

general considerations *2-3*
grounding the controller *3-6*

H

Half-Duplex *4-6*, *G-3*
hard disk *G-3*
hardware errors *C-6*
hardware features *1-1*
heat dissipation
  calculating *F-9*
heat protection *2-8*
high byte *G-3*

I

I/O (Inputs and Outputs) *G-3*
input device *G-3*
input states on power down *2-7*
inrush current *G-3*
installing
  ControlFlash software *D-1*
  memory module *2-13*
  your controller *2-1*
installing real-time clock *2-13*
instruction *G-3*
instruction set *G-3*
isolated link coupler
  installing *4-8*
isolation transformers
  power considerations *2-6*

J

jump *G-4*

L

ladder logic *G-4*
least significant bit (LSB) *G-4*
LED (Light Emitting Diode) *G-4*
LIFO (Last-In-First-Out) *G-4*
logic *G-4*
low byte *G-4*

M

manuals
  related *P-2*
master control relay *2-8*
  emergency-stop switches *2-10*
  using ANSI/CSA symbols schematic *2-12*
  using IEC symbols schematic *2-11*
Master Control Relay (MCR) *G-4*
master control relay circuit
  periodic tests *2-6*
memory module
  data file protection *6-4*
  operation *6-3*
  program compare *6-3*
  program/data backup *6-3*
  removal/installation under power *6-4*
  write protection *6-4*
minimizing electrical noise *3-14*
mnemonic *G-4*
Modbus communication protocol *E-17*
modem *G-4*
modem cable
  constructing your own *4-5*
modems
  dial-up phone *E-7*
  leased-line *E-7*
  line drivers *E-7*
  radio *E-7*
  using with MicroLogix controllers *E-6*
modes *G-4*
module error field *C-5*
motor starters (bulletin 509)
  surge suppressors *3-5*
motor starters (bulletin 709)
  surge suppressors *3-5*

N

negative logic *G-4*
network *G-5*
nominal input current *G-5*
normally closed *G-5*
normally open *G-5*
null modem cable *4-5*

O

offline *G-5*
offset *G-5*
off-state leakage current *G-5*
one-shot *G-5*
online *G-6*
operating voltage *G-6*
output device *G-6*

P

planning considerations for a network *E-10*
power considerations
  input states on power down *2-7*
  isolation transformers *2-6*
  loss of power source *2-7*
  other line conditions *2-7*
  overview *2-6*
  power supply inrush *2-6*
power distribution *2-6*
power source
  loss of *2-7*
power supply inrush
  power considerations *2-6*
preparing for upgrade *D-1*
preventing excessive heat *2-8*
processor *G-6*
processor file *G-6*
program file *G-6*
program mode *G-6*
program scan *G-6*
programming *1-3*
programming device *G-6*
protocol *G-6*
publications
  related *P-2*
purpose of this manual *P-1*

R

read *G-6*

real-time clock
battery operation *6-2*
disabling *6-2*
operation *6-1*
removal/installation under power *6-1*
writing data *6-2*
related documentation *P-2*
related publications *P-2*
relay *G-6*
relay contact rating table *A-4*
relay logic *G-6*
relays
surge suppressors for *3-5*
remote packet support *E-15*
replacement parts *B-1*
reserved bit *G-7*
restore *G-6*
retentive data *G-7*
Rockwell Automation support *P-3*
local product support *P-3*
questions or comments on this manual *P-3*
technical product assistance *P-3*
RS-232 *G-7*
RS-232 communication interface *E-1*
run mode *G-7*
rung *G-7*

S

safety circuits *2-5*
safety considerations *2-4*
disconnecting main power *2-5*
hazardous location *2-4*
master control relay circuit
periodic tests *2-6*
periodic tests of master control relay circuit *2-6*
power distribution *2-6*
safety circuits *2-5*
save *G-7*
scan time *G-7*
sinking *G-7*
sinking and sourcing wiring diagrams *3-10*
sinking wiring diagram
1762-24BWA *3-11*
sourcing *G-7*
sourcing wiring diagram
1762-24BWA *3-11*
specifications *A-1*
relay contact rating table *A-4*
status *G-7*
surge suppressors
for contactor *3-5*
for motor starters *3-5*
for relays *3-5*
recommended *3-5*
using *3-3*
system configuration
DF1 Full-Duplex examples *E-2*
DF1 Half-Duplex examples *E-4*
DH485 connection examples *E-13*
system loading
example calculations *F-1*
limitations *F-1*
worksheet *F-3*
system loading and heat dissipation *F-1*

T

terminal *G-7*
terminal block layouts *3-7*
terminal groupings *3-9*
terminal groupings *3-9*
throughput *G-8*
Trim Pot Information Function File *5-2*
trim pot operation *5-1*
trim pots *5-1*
adjustment *5-1*
error conditions *5-2*
location *5-1*
troubleshooting *C-1*
contacting Rockwell Automation for assistance *P-3*
true *G-8*

U

upload *G-8*
using communications toggle push button *4-2*
using emergency-stop switches *2-10*
using memory modules *6-1*
using real-time clock *6-1*
using trim pots *5-1*

W

wiring diagrams *3-7*
terminal block layouts *3-7*
wiring recommendation *3-1*
wiring your controller *3-1*
workspace *G-8*
write *G-8*

Reach us now at www.rockwellautomation.com

Wherever you need us, Rockwell Automation brings together leading brands in industrial automation including Allen-Bradley controls, Reliance Electric power transmission products, Dodge mechanical power transmission components, and Rockwell Software. Rockwell Automation's unique, flexible approach to helping customers achieve a competitive advantage is supported by thousands of authorized partners, distributors and system integrators around the world.

Americas Headquarters, 1201 South Second Street, Milwaukee, WI 53204, USA, Tel: (1) 414 382-2000, Fax: (1) 414 382-4444
European Headquarters SA/NV, avenue Herrmann Debroux, 46, 1160 Brussels, Belgium, Tel: (32) 2 663 06 00, Fax: (32) 2 663 06 40
Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1762-UM001A-US-P - January 2000

PN 40072-078-01(A)

© 2000 Rockwell International Corporation. Printed in the U.S.A.